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DIVISION OF MINES AND GEOLOGY
JAMES F. DAVIS
STATE GEOLOGIST

SEVENTY-FIFTH REPORT OF THE STATE GEOLOGIST

ACTIVITIES OF THE CALIFORNIA DIVISION OF MINES AND GEOLOGY JULY 1, 1982, THROUGH JUNE 30, 1983

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FOREWORD

Those who make land-use decisions in both the public and private sectors in California must accommodate the urban expansion and sound economic growth necessary to an expanding population and still enable the maintenance of an acceptable environment. The continued availability of mineral resources needed in our highly industrialized society is an especially important consideration when making land-use decisions. The levels of understanding behind such decisions range from broad general knowledge of California's complex geology and mineral resources to detailed knowledge of the geology and resources of a specific site.

To facilitate these broad and specific processes, the California Division of Mines and Geology (CDMG) carries out basic and applied geologic investigations of California's geologic environment, and provides information and advice to the general public, to the mining industry, and to local, state, and federal government agencies. Geologic information is available in both oral and written form from the three CDMG regional offices. CALIFORNIA GEOLOGY, a monthly magazine, technical reports and maps, and a wide variety of special information pamphlets, including CDMG Notes, are the publication vehicles for this geologic information.

All Division activities are based on the principle that knowledge of the fundamental geology of the state is important for the safety and economic well-being of the citizens of California.

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DIVISION PROGRAMS

The California Division of Mines and Geology (CDMG) is the state geological survey of California. As such, its primary function is to provide technical data to assist public agencies and the private sector in the wise and safe use of the earth's crust, its terrain, and its mineral resources. The broad objectives of the Division are: (1) to identify, delineate, and assist in the ultimate utilization of deposits of minerals, both onshore and offshore, consistent with wise conservation practices; (2) to identify and provide timely delineation of geologic hazards; and (3) to compile and, where needed, develop basic data on the geology of the state in support of geologic hazard and mineral resource investigations.

To achieve these broad objectives, the Division carries out a wide range of activities through six basic programs. These are: (1) the Minerals Program, (2) the Geologic Hazards Program, (3) the Geophysics Program, (4) the Environmental Geology Program, (5) the Geological Investigations Program, and (6) the Geologic Information Program. These six programs and their activities during fiscal year 1982-83 are described in the following pages.

Overview

MINERALS PROGRAM

The Minerals Program conducts investigations of mineral deposits and geologic terranes to provide public information on the extent, nature, and magnitude of the state's mineral resources. The goal of the program is to help the people of California and the nation meet future mineral needs. The program's classification of mineral lands according to the significance of the mineral deposits is used in land-use planning and regulatory programs administered by local government. Specific areas of program activity are (1) mineral resource analysis, (2) urban mineral land classification, and (3) nonurban mineral land classification.

GEOLOGIC HAZARDS PROGRAM

The Geologic Hazards Program provides information on geologic hazards, including landsliding, ground rupturing caused by fault movements, ground shaking caused by earthquakes, tsunamis (seismic sea waves), volcanic eruptions, land subsidence, expansive soils, and erosion. The information ranges in use from technical to lay applications. Areas of potential geologic hazard are delineated for land-use and emergency-response planning applications. Specific areas of program activity are (1) fault mechanism studies, (2) landslide studies, (3) marine geology studies, (4) cooperative studies (under cost-sharing agreements) with local government or other State agencies to identify geologic hazards, and (5) as-needed special investigations of dynamic geologic events and conditions that may have immediate effects on man such as damaging earthquakes or slope failures during storms.

GEOPHYSICS PROGRAM

The Geophysics Program provides specialized earth science expertise for assessing and mitigating volcanic, seismic, and other geologic hazards. This expertise is essential for evaluation of the seismic safety of critical and hazardous facilities and as input for the development of emergency-response plans and the design of earthquake-resistant structures. Specific areas of program activity are (1) earthquake strong-motion data collection, (2) seismological monitoring, (3) historical earthquake study, (4) geophysical studies, (5) reservoir-induced-seismicity investigations, and (6) the Cal-Mexico geologic hazards investigation.

ENVIRONMENTAL GEOLOGY PROGRAM

The Environmental Geology Program provides specialized scientific expertise for dealing with a variety of diverse environmental concerns ranging from the potential of geothermal heat as an alternative energy source in California to mined-land reclamation assistance and review, and the coordination of volcanic-hazard response and planning activities. Specific areas of program activity are (1) geothermal resource studies, (2) mined-land reclamation, (3) geochemical studies, and (4) volcanic hazards coordination.

GEOLOGIC INVESTIGATIONS PROGRAM

The Geologic Investigations Program provides both basic and applied geologic information--primarily, but not solely, in the form of maps. This information is used in mineral resource development, in land-use planning and regulation by local government, in timber harvest planning, in development-site evaluation studies, and in other endeavors requiring sound information on the geology of the state. Specific areas of program activity are (1) fault evaluation and zoning, (2) regional geologic mapping, (3) forest watersheds mapping and timber harvest plan review, and (4) subsurface investigations.

GEOLOGIC INFORMATION PROGRAM

The Geologic Information Program makes information prepared by Division program activities and other pertinent geologic information available to the general public, including local government, the scientific community, and the public at large. The products of Division investigations are edited, graphically prepared for printing, and reviewed by the publications staff. The State Geologist reviews all Division publications before they are released to the public or contracting agency. The program also provides technical review of siting reports for certain proposed developments within the state. Specific areas of program activity are (1) information and publications sales, (2) publications production, (3) geology library, (4) mineral exhibit, and (5) critical-siting report review.

I. Minerals Program

A major charge of the California Division of Mines and Geology (CDMG) is the provision of accurate and timely information on the state's mineral resources. To provide this information CDMG studies mineral occurrences in the state and monitors mining activities. The resulting information is published in mineral investigation reports, mineral commodity reports and maps, and various other timely reports on mines and mineral production. Specific advice is available through direct consultation with CDMG's minerals staff.

CDMG minerals studies involve the collection and interpretation of a wide range of specialized and, in some cases, confidential information. Data must be interpreted in light of an understanding of the processes of geologic deposition and mineralization. The extreme complexity of California's geologic makeup makes this a challenging task. This complexity is largely attributable to the state's position at the edge of the continent where one major plate of the earth's crust is being pressed against and under another major plate. The slow, ongoing process of adjustment to this convergence of tectonic plates has enlarged the continent and resulted in volcanism, the formation of mountain ranges, major displacements of land masses along faults over time (to say nothing of periodic earthquakes), and numerous other dramatic as well as subtle geologic developments that are responsible for the abundance and diversity of mineral occurrences in California.

Providing focused minerals information, which is the broad objective of CDMG's mineral resource analysis unit, is an important responsibility in California, one of the nation's leading producer's of non-fuel minerals. The agricultural, manufacturing, and construction industries of the state are supplied by numerous mineral commodities produced by the mining industry of California. Approximately $1.6 billion in mineral commodities are produced in the state annually. California is the leading producer of asbestos, boron, portland cement, diatomite, sand and gravel, rare earths, and tungsten. It is also a major source of natural gas, liquefied petroleum gases, salt, clay, stone, magnesium compounds, sodium compounds, gypsum, iron ore, and talc.

Not only does California have a very large current mineral production, it has extensive undeveloped mineral resources. Some of these--including chrome, cobalt, gold, mercury, nickel, platinum group metals, silver, titanium, and zeolites--are of national strategic value.

An especially important goal of CDMG's minerals program is to help assure a continuing supply of minerals of vital importance to the well-being of the state and nation. Many of these mineral resources are relatively abundant, high-bulk, near-surface materials; others are more scarce and unevenly distributed over the earth's surface. Both types of mineral resources, as sources for meeting future demands, are threatened by urbanization and other land-uses incompatible with mining. With proper management of the resource areas, however, the needed materials can be made available in adequate quantities long into the future.

The Surface Mining and Reclamation Act (SMARA) of 1975, as amended, provides the mechanism by which known mineral resource areas can be managed to ensure their continued availability for mineral extraction, while also requiring that mined lands be reclaimed for subsequent land-uses compatible with the environment. SMARA authorizes the State Geologist to identify land areas containing mineral deposits of regional or statewide significance so that local governments can incorporate this information in their general plans for future development. Regionally significant deposits of abundant, high-volume, near-surface materials as well as deposits of more scarce mineral materials having statewide or national significance are identified so that, if warranted, measures can be taken to assure the availability of these mineral lands for possible future mineral extraction.

1. Mineral resource analysis program (MRAP)

The overall goal of the mineral resource analysis unit is to provide the public, the mineral industry, and government decision-makers with up-to-date information concerning California's mineral industry, mineral economics, and mineral resource potential.

An on-going project carried on by the unit involves maintaining a source of information concerning current mining activities in California. This project uses information obtained from a review of current published and unpublished literature supplemented by visits to active mineral producers and mining operations. Data obtained during mineral industry and mine visits are entered on property report forms and placed in the Division's property report files. Information from these files and production statistics obtained from the U.S. Bureau of Mines are combined each year to produce the California mineral industry report published in CALIFORNIA GEOLOGY. This information also is used in the periodic updates of the Division's Special Publication, "Mines and Mineral Producers Active in California," and is entered on the Division's master computer index system. The Mineral Property Report forms are also used to answer mineral resource inquiries from government, industry, and the general public.

The mineral resource analysis staff completed several short-term projects. One project was the compilation of a series of occurrence and favorability maps for nine strategic minerals (at a scale of 1:1,000,000 with accompanying explanation and bibliography); the minerals treated in these compilations are silver (occurrence only), manganese (occurence only), platinum (occurrence only), tin (occurrence only), titanium, tungsten, nichol and cobalt, and chromite. Another project was a study of clay in the greater Los Angeles area to identify areas of possible future study; this resulted in proposals entailing the study of clay production and of the geology of clay-bearing formations in the greater Los Angeles area as well as a recommendation for a study to describe a new location of high alumina clay in the San Gabriel Mountains. Numerous mineral-lands impact reviews of Wilderness Study Area reports for the U.S. Bureau of Land Management were also completed.

A number of mineral resource commodity studies were started during fiscal year 1982-83. These include studies of titanium, zeolites, phosphates, nitrates, lime, sulfur, gypsum, potash, and salt. Also undertaken was a special mineral resource assessment of the San Gabriel anorthosite massif. The most important goals of this study are to identify areas of titanium favorability and to estimate the economic potential of associated phosphorus and vanadium. The end product

Photo 1. Mud Hills zeolite mine, owned by Phelps Dodge Zeolites, near Barstow, San Bernardino County, California. At Mud Hills, the zeolite mineral clinoptilolite is present in altered tuff beds of the Miocene Barstow Formation. Material from this mine was sold to British Nuclear in 1982 to be used as a molecular sieve for the removal of radioactive cesium and strontium from nuclear reactor waters.

Photo 2. The Lone Star Industries, Clayton Plant #135 a crushed rock quarry at Clayton, Contra Costa County, California. The apparently readily accessible mining terrain of this quarry is being encroached upon by the urban development that extends outward from the San Francisco Bay area megopolis.

of the study will be a report suitable for publication as a CDMG bulletin. The bulletin will include a text and two plates.

Another project started and in progress is a study of zeolites in California. This project will culminate in a report suitable for publication as a CDMG special report with two plates--an occurrence map and a favorability map--at a scale of 1:1,000,000.

A number of other mineral resource analysis activities were planned for fiscal year 1983-84. Included among these are analyses of the geochemical data available from the Department of Energy National Urbanium Resource Evaluation (NURE) program, and a study of lode gold mineralization in the Mother Lode area.

2. Surface Mining and Reclamation Act

The continued availability of mineral resources that are critical to California's economy and the reclamation of mined lands are the twin and interrelated objectives of the Surface Mining and Reclamation Act of 1975 (SMARA). These objectives are reached through land-use planning and regulatory programs administered by local government. The California Department of Conservation, the Division of Mines and Geology, and the State Mining and Geology Board are the State agencies responsible for administering the State's role in this program.

Three interrelated units within the Division have been established to implement the goals of SMARA. These are the urban and the country mineral land classification units, discussed here, and the mined land reclamation unit (see page 29 for discussion). These units represent a cost-effective means of ensuring that California's mining industry may continue to provide society with needed mineral commodities in an environmentally sensitive manner.

a. Urban mineral-land classification (1st element of SMARA)

The objective of the urban mineral-land classification unit ("City SMARA") is the identification of lands containing a mineral deposit that, because of its regional or statewide significance, may deserve regulatory protection by local government to assure the availability of the deposit for future extraction. This objective is achieved through a mineral inventory and economic assessment process termed "classification-designation," which jointly involves the Division and the State Mining and Geology Board. Information on the location of important mineral deposits is developed by the Division through the process of mineral-land classification. This information is used by the Board in designating those deposits that are of economic significance to a region, the state, or the nation. Local government uses this information in developing mineral resource management policies and in making land-use decisions to assure the conservation and development of these resources

Although CDMG is involved only in the classification phase of classification-designation, an understanding of designation is needed to understand the role of classification in the overall process.

Designation is the prerogative of the State Mining and Geology Board. The Board may designate areas within a mineral production-consumption (P-C) region that contain siginificant deposits of the mineral material or materials under consideration for designation. The Board has given first priority to the classification-designation of construction aggregate deposits of Portland-cement-concrete (PCC) grade, in urban and urbanizing areas. The Board's decision to designate particular areas is based on information in mineral land classification reports prepared by CDMG and on input from lead agencies and the public. In designating an area, the Board is providing formal recognition that that area contains regionally significant deposits. SMARA requires that local governments incorporate the classification-designation information in their general plans for land-use and development.

As noted above, CDMG is responsible for carrying out the classification phase of the classification-designation process. Classification normally entails six distinct but interrelated steps. These classification steps will be explained here in the context of the classification of PCC-grade aggregate, which is the mineral material that the City SMARA unit is at present primarily engaged in classifying.

The first classification step is to determine the boundaries of the production-consumption region under study. The boundaries are drawn along the limits of the marketing area of the active aggregate operations supplying the urban center under study. Included within the production-consumption region boundaries are all areas within the marketing area that have been identified as urbanized or urbanizing.

In step two, all lands considered to be urbanized or urbanizing are assigned Mineral Resource Zone classifications (MRS-1--no significant deposits present; MRZ-2--significant deposits present; MRZ-3--insufficient data to determine significance of deposits; MRZ-4--insufficient data to identify deposits) based upon a geologic appraisal of the aggregate resource potential of the land. This appraisal includes study of pertinent geologic reports and maps, field investigation and sampling at outcrops and at active and inactive pits and quarries, and analysis of water-well logs and drill records.

In step three, lands classified as containing significant deposits of PCC-grade aggregate material (areas classified MRZ-2) are evaluated to determine whether or not current uses of these lands preclude possible future mining. Areas currently permitted for mining and areas found to have land uses compatible with possible future mining are considered available for mining, and are delineated as "sectors"--that is, available aggregate source areas.

In step four, for each sector, total tonnages of PCC-grade aggregate reserves (deposits permitted for mining) and resources (all deposits of PCC quality including the reserves) are calculated based upon field investigation and surface measurement, drill-hole information, waste-material percentages, and deposit densities.

In step five, 50-year needs of the production-consumption region are estimated based upon population growth projections and average annual per capita aggregate consumption rates. Based upon these calculations, the life

expectancy of current reserves is estimated, and projected needs are analyzed in relation to current reserves and resources.

Step six involves a consideration of possible alternative sources for PCC-grade aggregate needed to meet the forecast 50-year demand for the production-consumption region.

CLASSIFICATION. During fiscal year 1982-83 the City SMARA program completed a number of mineral land classification reports (see Figure 1) for construction aggregate materials:

- San Gabriel Valley Production-Consumption Region, Los Angeles County. This report, one of a series of classification reports covering parts of the greater Los Angeles area, was published as Special Report 143, Part IV. The last three reports planned for this series (Saugus-Newhall-Palmdale, Claremont-Upland, and San Bernardino) were in preparation at year's end.

- Western San Diego County Production-Consumption Region. This classification report was completed and was in press at year's end. (It was published in September 1983.)

- South San Francisco Bay Production-Consumption Region. This classification report, the first of three classification studies covering the greater San Francisco Bay area, was completed to Headquarters-review stage at year's end.

- North San Francisco Bay Production-Consumption Region. This classification report, the second of three classification studies covering the greater San Francisco Bay area, was completed to Headquarters-review stage at year's end.

- Monterey Bay Production-Consumption Region. This classification report, the last of three classification studies covering the greater San Francisco Bay area, was completed to Headquarters-review stage at year's end.

PETITIONED CLASSIFICATION REPORTS. Several mineral land classification reports were prepared in response to petitions submitted to the State Mining and Geology Board by mining property owners. In such cases, classification studies are conducted when the mineral land in question contains significant mineral deposits and is being encroached upon by other land developments that are incompatible with mining.

- Pacific Clay Products Alberhill Property. A classification study of a clay-bearing area near Alberhill, Riverside County, was released on open-file as OFR 81-16 LA. An area underlain by significant deposits of clay used in manufacturing clay products was classified.

- Riverside Cement Company Plat$_3$ Property. A classification study of the Plat$_3$ property clay deposit located in the Trabuco Canyon area of Orange County was released on open-file as OFR 82-6 LA. Parts of the property underlain by kaolinitic clay used in manufacturing white cement were classified.

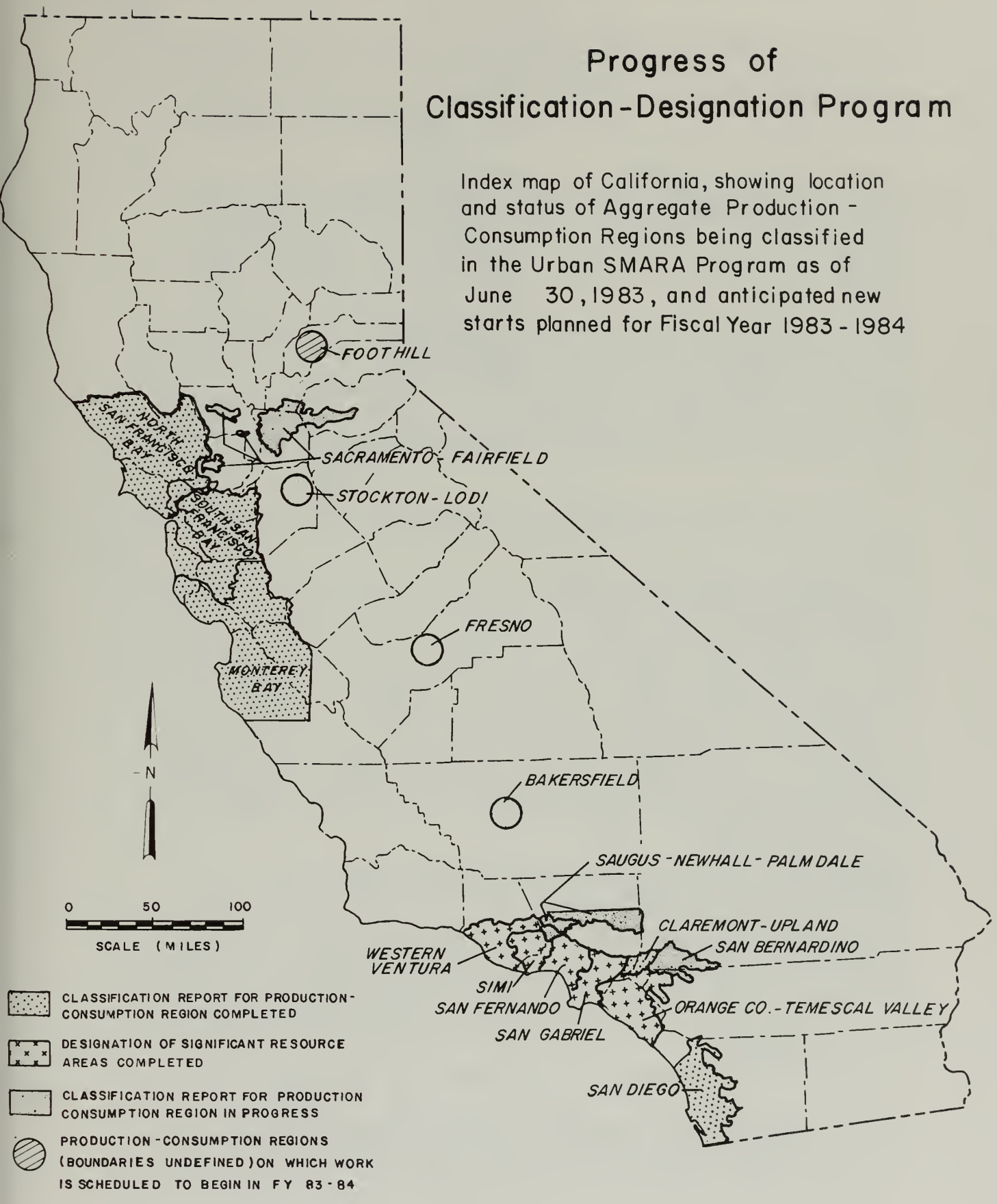
Progress of
Classification-Designation Program
Index map of California, showing location and status of Aggregate Production - Consumption Regions being classified in the Urban SMARA Program as of June 30, 1983, and anticipated new starts planned for Fiscal Year 1983 - 1984
FOOTHILL
NORTH SAN FRANCISCO BAY
SOUTH SAN FRANCISCO BAY
SACRAMENTO - FAIRFIELD
STOCKTON - LODI
FRESNO
MONTEREY BAY
BAKERSFIELD
SAUGUS - NEWHALL - PALMDALE
CLAREMONT - UPLAND
SAN BERNARDINO
WESTERN VENTURA
SIMI
SAN FERNANDO
SAN GABRIEL
ORANGE CO. - TEMESCAL VALLEY
SAN DIEGO
N
0
50
100
SCALE (MILES)
CLASSIFICATION REPORT FOR PRODUCTION-CONSUMPTION REGION COMPLETED
DESIGNATION OF SIGNIFICANT RESOURCE AREAS COMPLETED
CLASSIFICATION REPORT FOR PRODUCTION CONSUMPTION REGION IN PROGRESS
PRODUCTION-CONSUMPTION REGIONS (BOUNDARIES UNDEFINED) ON WHICH WORK IS SCHEDULED TO BEGIN IN FY 83-84

Figure 1. Status of the Urban SMARA Classification Designation Program, June 30, 1983.

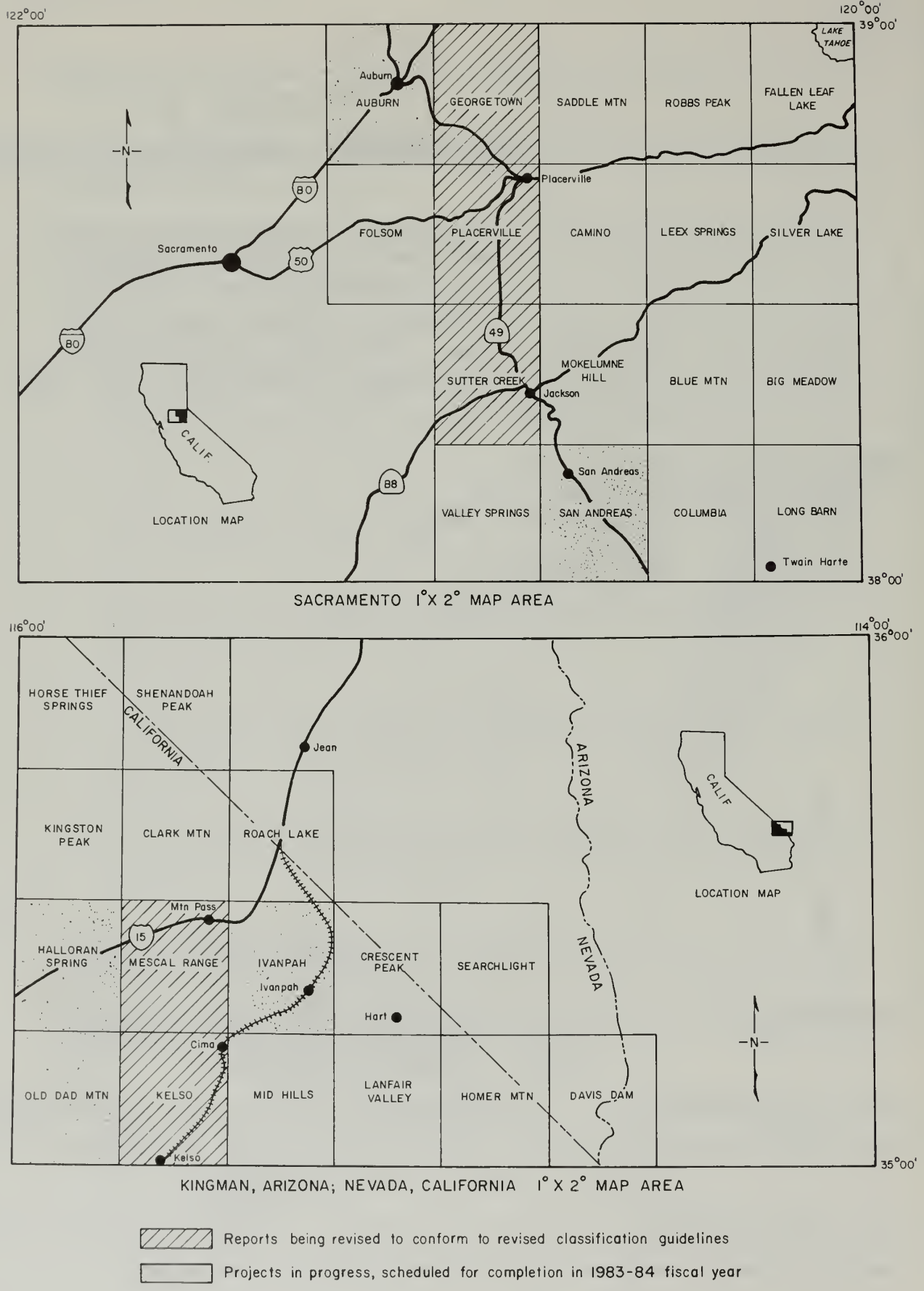

Figure 2. Country SMARA Mineral Land Classification program status, June, 1983. Reports being revised to conform to revised classification guidelines. Projects in progress, scheduled for completion in 1983-84 fiscal year.

- Pluess-Staufer Limestone Deposit. A classification study of a limestone deposit located near Lucerne Valley in western San Bernardino County was released as OFR 82-8 LA (superseded by OFR 84-21 LA). An area underlain by high-quality limestone used in industrial products was classified.

- Joe Chevreaux Company Property. A classification study of a sand-and-gravel deposit (in Nevada and Placer counties) suitable for use in Portland cement concrete was completed at year's end (and subsequently released as OFR 83-28 SAC). The area classified provides special aggregate material for a market that extends well beyond California.

DESIGNATION. Designation of classified sand and gravel resources in urban areas is underway. Designation of regionally significant mineral resources in the San Fernando Valley, the Simi Valley, and western Ventura County regions has been completed. Currently, designation in the San Gabriel Valley and in the Orange County-Temescal Valley regions is under consideration. For additional information on designation, see the Mining and Geology Board's annual report for fiscal year 1982-83.

b. Non-urban mineral-land classification (2nd element of SMARA)

As authorized by the Surface Mining and Reclamation Act of 1975 (SMARA) and Senate Bill 1300, the State Mining and Geology Board passed a resolution in March 1981 directing the Division to undertake mineral-land classification studies within the foothill region of the Sierra Nevada Mountains and in the California Desert Conservation Area. This classification work is known as "Country SMARA." These areas contain mineral resources of regional or statewide significance that could be adversely affected by land-use decisions that would preclude mining from such places. The State Mining and Geology Board, which sets priorities for the classification studies, determined that work would begin in the foothills portion of the Sacramento 1° X 2° quadrangle and in that part of the Kingman 1° X 2° quadrangle that is within the California Desert Conservation Area (Figure 2).

The Country SMARA mineral-land classification unit was activated upon receiving an order of priority for classification. Each classification project was structured into three phases: (1) assembling and evaluating existing geologic, geophysical, and mine data pertaining to the area; (2) undertaking geologic field investigations, mine examinations, and in some instances geochemical surveys; and (3) preparation of a geologic report and mineral resource classification map of the area based upon a synthesis and analysis of data gathered during phase I and phase II of the project.

The area represented by the Placerville 15' quadrangle portion of the Sacramento sheet was chosen as the "pilot area" in which to begin the country mineral-land classification. An outcome of the pilot project was a recognition of the need to establish special guidelines for the classification of non-urban areas. This was done during fiscal year 1982-83. The revision of the Placerville report (the first version had been released as OFR 82-1 SAC) is scheduled for release in September 1983. (It was subsequently released as OFR 83-29 SAC.)

Country SMARA mineral-land classification field activity continued during fiscal year 1982-83 in the foothills portion of the Sierra Nevada Mountains and in the California Desert Conservation Area. Field work and data gathering for the following quadrangles were completed at year's end: Georgetown, Sutter Creek, Kelso, Mescal Range, and Halloran Springs. In progress are revised reports (reports following the earlier guidelines had been completed) for these quadrangles based upon the interpretation of data required by the revised classification guidelines.

Country mineral-land classification products have received considerable interest from several groups. Staff geologists assigned to the program have received numerous inquiries from local governments as well as the mineral exploration community about the scope of the program and the availability of the results of these investigations.

3. Mineral lands impact review

Responding to federal and local land-use planning reports that impact on mineral resource lands is another important function of CDMG's Minerals Program. CDMG represents the State's interest in mineral resource lands in California. Land-use planning decisions that effect mineral resource lands in the state, whether they are State, Federal, or private lands, are a matter of concern to the State. The importance of reviewing these planning reports is most dramatically illustrated by the fact that primary responsibility for land-use planning and regulation for nearly 50 percent of the land area in California is in the hands of the Federal Government. CDMG plays a key role in the inter-governmental decision-making process that determines the land-use regulations for these large areas.

I I. Geologic Hazards Program

The Geologic Hazards Program provides geologic information--in the form of maps and interpretive texts--about geologic hazards in the state. The products present both technical and lay information useful and necessary for public safety purposes. The information is provided in the form of geologic reports and maps resulting from specialized studies of specific hazards. Potentially hazardous geologic conditions are best identified prior to land development if possible. Identifiable hazardous geologic conditions need to be recognized so that action can be taken to prevent the potential losses, injuries, or even deaths that they might cause. These hazards include landsliding, ground rupturing caused by fault movements, ground shaking caused by earthquakes, tsunamis (seismic sea waves), volcanic eruptions, land subsidence, expansive soils, and erosion. Knowledge of potential geologic hazards is critical to the land-use planning process.

Activities directly within the Geologic Hazards Program are: (1) fault mechanism studies; (2) landslide studies; (3) marine geology studies; (4) cooperative studies (under cost-sharing agreements) with local government or other State agencies to identify geologic hazards; and (5) special emergency investigations of occurrences such as slope failures during storms and earthquake events. Typical products include county-wide investigations of all geologic hazards present and large-scale quadrangle mapping which emphasizes slope-stability, erosion, faulting, expansible soil, or other conditions that could become hazards to public safety, or lead to property damage.

1. Fault mechanism studies

Fault mechanism studies underway during the period of this report include work on the San Andreas fault, the San Gabriel fault, the Newport-Inglewood structural zone, and faults in San Diego and Imperial counties. Preparation of a comprehensive summary of nearly ten years of Division mapping and study of the San Andreas fault in Los Angeles County is underway. Eight large-scale geologic maps and 11 annotated fault maps, with cross sections and explanatory data, have been completed. Additional work was done on a continuing study of the general characteristics, recency of movement, and potential for future activity of the San Gabriel fault zone. Analysis of oil well E-logs was performed for a portion of the Newport-Inglewood structural zone in the Santa Ana Gap area of Orange County in order to evaluate the presence and recency of activity of fault strands in this area. A report is in preparation which concludes that several "faults" shown on published maps do not exist. Analysis of aerial photos and compilation of a fault activity and Quaternary tectonic map for parts of six 1:100,000-scale metric topographic maps of San Diego-Oceanside to Salton Sea-El Centro began during the reporting period. In addition, Division geologists investigated the ground cracks and fissures that formed in March 1983 in the vicinity of Cantil, Kern County, and prepared a report submitted to the Office of Emergency Services.

2. Landslide studies

Four reports resulting from studies of landslides and related slope failures were released during the year. One of these, Special Report 152, "Slope Stability and Geology of the Baldwin Hills," constitutes the final report of a study

mandated by A.B. 1571, authored by Assemblywoman Gwen Moore, and signed into law in 1980. The hills, in Moore's district, were heavily damaged by slope failure in 1978 and 1980. The report features a large scale, multi-colored map (Plate I) on which are presented geologic, slope failure, and other pertinent data. Such presentation of these data is necessary for designing a program to stabilize slopes on residential properties in the Baldwin Hills.

Three additional reports released were prepared as part of the program of financial cooperation between the Division and the U. S. Geological Survey to inventory landslides in selected areas of southern California. These are open file reports: OFR 82-12 LA, "Recent Slope Failures, Ancient Landslides, and Related Geology of the North-Central Coastal Area, San Diego County" (this is one of the fastest growing areas in the United States and suffered numerous slope failures in 1980); OFR 82-26 LA, "Investigation and Inventory of Slope Failures that Occurred in 1978 and 1980 in the Los Angeles 7 1/2-minute Quadrangle, Los Angeles County" (more than 800 damaging slope failures were mapped, mostly in portions of the cities of Los Angeles and Monterey Park); and OFR 83-16 LA, "Map Showing Landslides of the Central and Western Santa Monica Mountains, Los Angeles and Ventura Counties" (an area of many pre-historic landslides and the site of numerous slope failures during each period of recent heavy rains).

Additional studies of landslides in southern California underway or nearing completion are: a detailed report on 1978 and 1980 slope failures in southern California, with sections on general features of landsliding and related subjects, being prepared for publication as a Special Report; and open-file reports inventorying recent slope failures in the Topanga and Canoga Park quadrangles in os Angeles County and the Dana Point and San Clemente quadrangles in Orange County, including those that occurred in 1983.

At the end of fiscal year 1982-83, in recognition of the seriousness and widespread nature of the landslide hazard in the state, the California State Legislature was considering a bill that, if enacted, would establish a landslide hazard identification program to be carried out by CDMG. Assembly Bill No. 101 would require the establishment of a program to develop maps of landslide hazards within urban and urbanizing areas of the state. (The Landslide Hazard Identification Act was subsequently signed into law by ~overnor Deukmejian on September 21, 1983.)

3. Marine geology studies

CDMG's marine geologist is conducting a major synthesis of offshore California geology. This fiscal year was the third year of his work preparing a geologic synthesis of the California continental margin. The maps depict bedrock and surficial geology as well as character and recency of faulting, landslides, sediment creep, sediment conduits, Bouguer gravity anomalies, magnetic anomalies, earthquake epicenters, and selected focal mechanisms. They are being compiled at a scale of 1:250,000 on NOS bathymetric bases. The first of these maps are currently being prepared for publication by CDMG and will be accompanied by a comprehensive bibliography of geological and geophysical studies conducted within this area as well as by an explanation of symbology, developed largely during this study, that uses example seismic data as a reference

for the user. The first part of the study to be released includes the southern California continental margin from Mexico to Palos Verdes and from the shoreline to the Patton Escarpment.

Fiscal year 1982-83 saw the completion of marine geologic data compilation of the entire southern California offshore as well as a portion of central and northern California offshore, including the Monterey, San Francisco, Cape Mendocino, and Eel River basins.

CDMG's marine geologist is also currently involved in high resolution data acquisition and processing for selected areas of the California continental margin where detailed information is necessary to solve specific questions that have arisen from our regional geologic synthesis.

The offshore California geologic synthesis is being conducted by CDMG as a cooperatively funded project between the California Coastal Commission, the U.S. Geological Survey, and the California Division of Mines and Geology.

Marine geology studies underway during fiscal year 1982-83 include:

1. Geologic synthesis of the southern California continental margin;
2. Observations of offshore Quaternary faults made from DSV ALVIN;
3. Earthquake related hazards in the offshore Los Angeles basin;
4. Structural transect, Salton Trough to Patton Escarpment; and
5. Geologic synthesis of offshore Monterey-San Francisco.

4. Cooperative studies with county and local governments

The Division conducts a number of geological studies in cooperation with local government and other State agencies to provide needed technical information about areas of actual or potential geologic hazard. Cooperative activities are funded jointly by the Division and the cooperating agency under various arrangements, the nature of which depends upon the availability of funds and personnel, the relative urgency of the project to the State and to the cooperating agencies, and other factors. Cooperative activities with counties were either suspended or reduced owing to the changed budgetary conditions of both counties and the State after July 1, 1978.

a. Los Angeles County

The Los Angeles County Flood Control District provided funding ($18,000) in the 1982-83 fiscal year for continued work to accelerate the Division's geologic studies initiated under previous funding arrangements in Los Angeles County. An open-file report was completed on the south half of the Mint Canyon quadrangle. Two other reports (parts of Newhall and Pasadena quadrangles) were reviewed, revised, and at year's end nearly complete for open-file reports. Work continued on a reduced basis on the final phase (report preparation) of a 5-year study of the San Andreas fault zone along the northern portion of Los Angeles County. In previous years, this study was partly funded by the County of Los Angeles, Department of County Engineer. (U.S. Geological Survey support of the study continued through the year.)

b. Orange County

Work continued, on a reduced basis, on projects initiated and well-advanced under previous cooperative funding arrangements with Orange County. Reports on parts of Santiago Peak, Black Star Canyon, El Toro, and La Habra, Yorba Linda and Prado Dam quadrangles were nearly complete for open file reports at year's end. A report was completed to Headquarters review stage on an investigation (done in cooperation with the U.S. Geological Survey) of the ground response from seismically induced shaking in a portion of Orange County.

5. Special investigations

Division geologists responded as needed to evaluate the hazard potential of ongoing geologic events. Several of these evaluations were made at the request of the State Office of Emergency Services or local government. Examples of such investigations include the Coalinga earthquakes of May and June; ground cracks and fissures that formed in March 1983 in the vicinity of Cantil, Kern County; and winter storm slope failures, especially in the San Francisco Bay area.

During the heavy winter rains which fell in the San Francico Bay area during January through April 1983, CDMG provided emergency support services to seven counties and ten cities. Many of these local government agencies do not have a full-time geologist on their staffs. Typical response by CDMG to telephone inquiries by local building officials and public works directors involved analysis of the relative severity of the landslide condition, help in determining the extent of mass movements, and informal advice concerning temporary remedial measures. Most of the CDMG assistance involved on-site verbal advice; formal written reports were not prepared because of the great number of concurrent landslides.

Special assistance was provided on the Blucher Valley landslide near Sebastopol; an article on the geology of this landslide was published in the August 1983 issue of CALIFORNIA GEOLOGY. A team of six CDMG geologists from the Division's San Francisco office assisted local officials in Santa Cruz County with initial geologic work on the Lompico Road landslide. This landslide severed the sole access route to a mountain hamlet with about two thousand residents. CDMG provided advice for the location of a temporary access road, and prepared a geologic map of the landslide and several detailed geologic cross sections which were used by Santa Cruz County officials to request federal disaster aid. Approximately $26,000 was spent in fiscal year 1982-83 on emergency response for landslides in the San Francisco Bay area. Approximately 42 man-days were spent in the field over a four-month period of heavy winter rains.

III. Geophysics Program

The goal of the Geophysics Program is to increase public safety by mitigating geologic and seismic hazards and assessing associated risks. Specific objectives include providing technical advice during periods of heightened volcanic or seismic hazards, evaluating the seismic safety of critical and hazardous facilities, and contributing to the development of emergency response plans and earthquake-resistant design.

1. Earthquake strong-motion data collection (SMIP)

A central problem confronting engineers in their efforts to design earthquake-resistant structures is the lack of knowledge regarding the force of ground motion and the deformation induced in structures by earthquake-generated ground motion. The Strong-Motion Instrumentation Program (SMIP) was created to provide the needed information on ground and structural responses to earthquakes in California. SMIP was established after the San Fernando earthquake in 1971, when Chapter 8 of Division 2 of the Public Resources Code (SB 1374) was signed into law. The California Division of Mines and Geology was designated as the responsible managing agency.

SMIP is installing, maintaining, and monitoring a network of strong-motion instruments to study the nature of strong earthquake motion and to collect, process, and disseminate data for application to the design of earthquake-resistant structures. This activity is supported by a special fund derived from a fee applied to construction permits issued by cities and counties. The objective of the strong-motion program is to obtain statewide detailed records of the response of rock and soil units and of engineered structures to strong shaking caused by earthquakes. The accelerograph, an instrument that measures the forces generated by seismic waves, is used to record these data.

The sites instrumented by SMIP are selected with the advice and assistance of the Strong Motion Instrumentation Committee of the Seismic Safety Commission. The Committee encourages a variety of individuals, organizations, and agencies to nominate sites and structures for instrumentation. In this way, the Committee has prepared a list of nominations for instrumentation that includes 70 buldings, 35 transportation structures, 30 dams, and 17 lifeline facilities such as power plants and water transmission and storage structures. In addition, the Committee has assisted in the selection of approximately 280 ground response sites, and is presently preparing an additional list of 50 buildings. Ultimately, the State strong-motion instrument network will include about 400 buildings, 30 dams, 40 transportation structures, 25 lifeline facilities, 400 isolated ground response sites, and 20 special arrays.

During the fiscal year 1982-83 the Strong Motion Instrumentation Program completed its eleventh year of operation. SMIP activities are conducted from offices in Sacramento and San Bernardino. During the eleven years of operation, a total of 297 permanent and 20 temporary ground response stations, comprising 951 seismic data channels, have been installed. In addition, 56 buildings comprising 692 data channels, 21 dams comprising 231 data channels, and 5 transportation structures comprising 103 data channels have been instrumented. The map in Figure 3 shows the location of the SMIP stations as of June 1983.

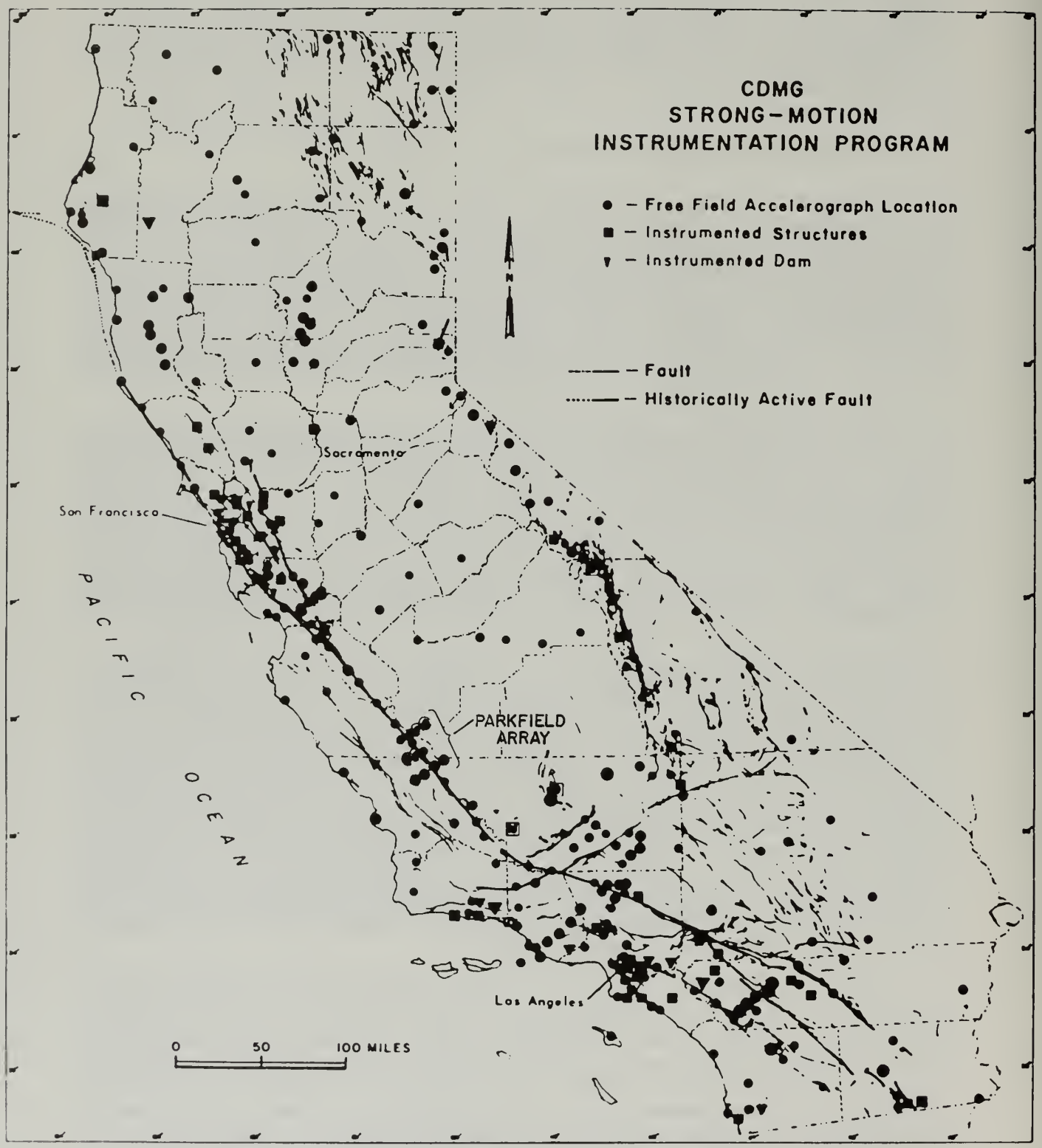

Figure 3. Status of the Strong Motion Instrumentation Program, June 1983.

An accelerogram digitizing and processing function was an important addition to the program activities. This addition makes SMIP a complete and comprehensive program with full capability for processing and disseminating strong-motion data to the user community. During fiscal year 1982-83 the processing system, which is patterned after an existing system at the University of Southern California, became operational. Accelerogram digitization and processing are now performed on a routine basis. The recent Coalinga earthquake has provided a large set of valuable data to be processed.

Strong-motion instrument installation activity during 1982-83 included the installation of 23 ground response stations with a total of 69 seismic data channels, and the instrumentation of three buildings with a total of 39 seismic data channels. A significant effort was expended during the last two years in the installation of 43 ground response stations in a carefully designed dense array in the vicinity of Parkfield. This large array, shown on the map in Figure 4, was completed this year.

Strong-motion data recovery during this year was dominated by the large set of data generated by the Coalinga earthquake. Accelerograms were recovered from 60 SMIP strong-motion stations following the earthquake; 46 were from the recently-completed, Parkfield strong-motion array. These data will be valuable in improving our knowledge of site and propagation effects on strong ground shaking. Digitization and processing of this data were underway at the year's end.

2. Seismological monitoring

Five seismographic recorders are maintained in the Sacramento area by CDMG seismologists. Seismographs record vibrations caused by earthquakes. These recorders are distributed as follows: one at the State Capitol, one at the Resources Building, and three at the Sacramento regional office. The recorders at the Capitol and Resources Building have been popular exhibits since their installation, and enable the public and legislative people to be aware of California seismicity in real-time. The three recorders in the Sacramento regional office receive telemetered signals from northern, central, and southern California, including signals from Department of Water Resources (DWR) stations. The immediate awareness of California's earthquake activity helps the Division in its activities related to post-earthquake response and coordination functions with other state, federal, private, and local organizations dealing with public safety and field programs.

The Seismological Laboratory at CalTech and the Seismographic Stations, U.C. Berkeley, continue to supply timely information for earthquakes of magnitude 4 or greater. This cooperation allows the timely construction of a preliminary annual seismicity map for California (see Figure 5). A summary of the magnitude distribution for events during 1982-83 is as follows: M4-4.9 (63 events), M5-5.9 (12 events), and M6-6.9 (1 event). The one event of M6-6.9 was the May 2, 1983 Coalinga shock described in the following section. Accompanying the large event were about six M5-5.9 aftershocks--a significant release of seismic energy for an area which had not experienced a magnitude 6 event during historical time.

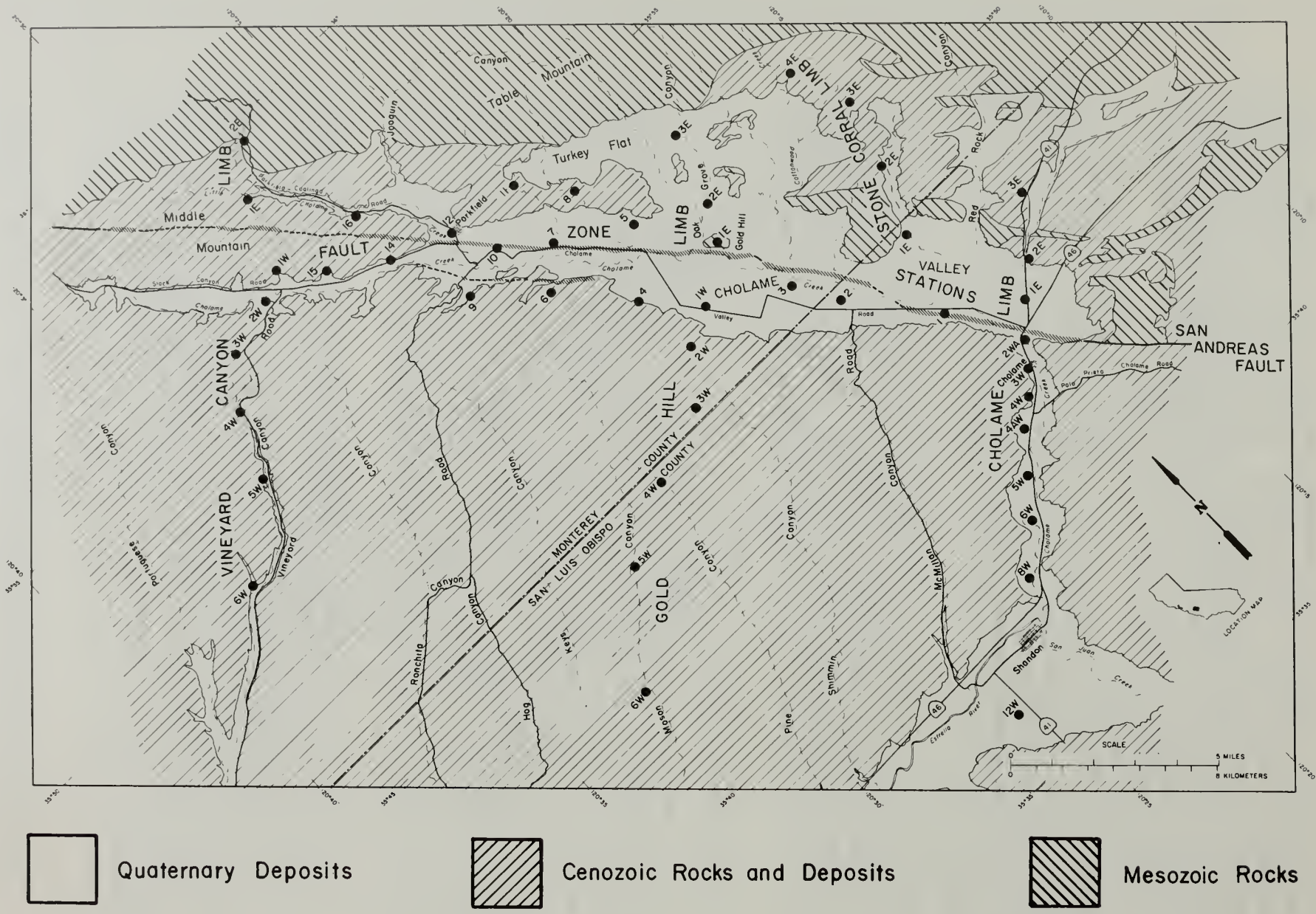

Figure 4. CDMG Parkfield strong-motion array and generalized geology along the San Andreas Fault. Installation of the array was completed by SMIP during 1982-83.

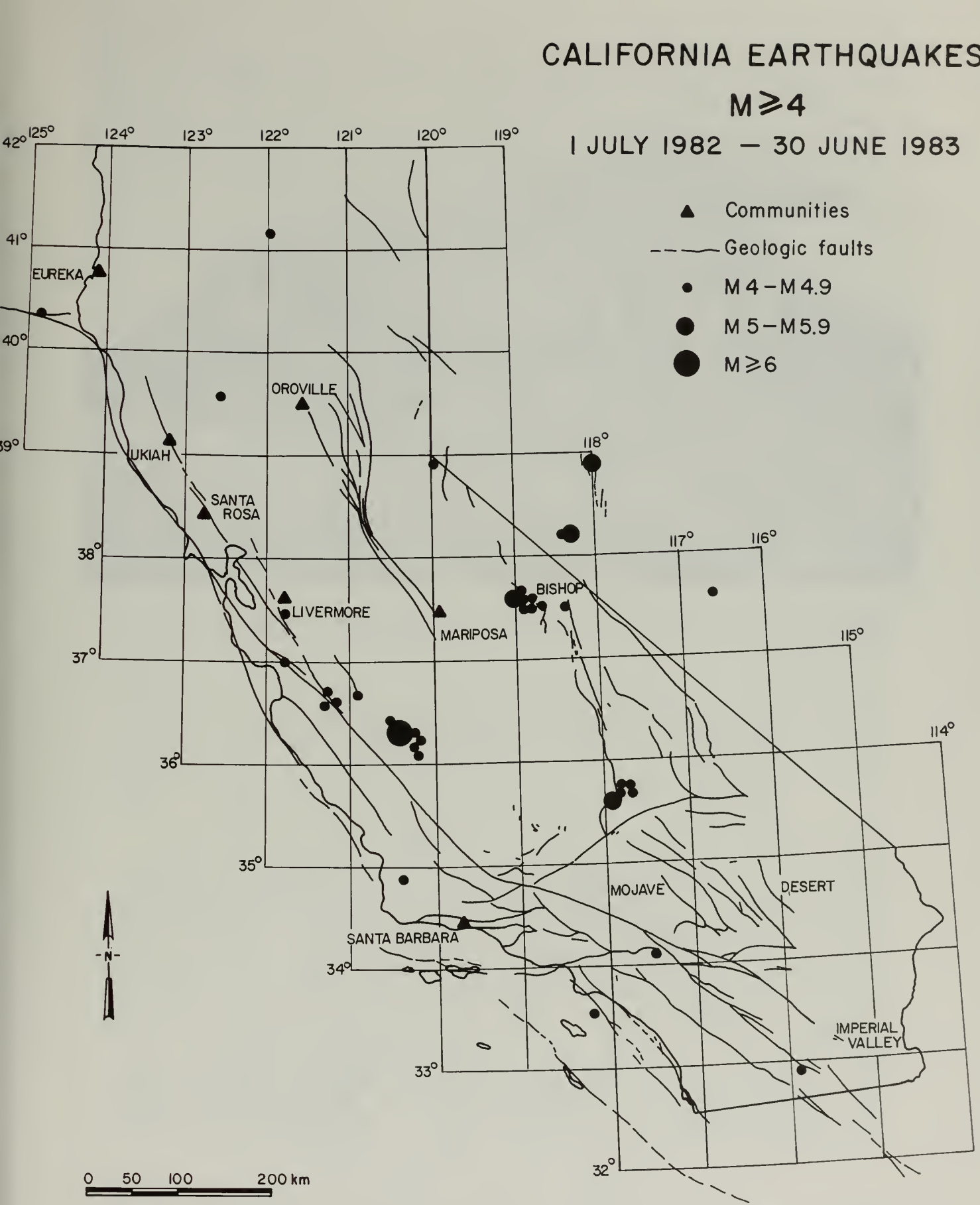

Figure 5. Preliminary map of seismicity in California during fiscal year 1982-83.

Photo 3. Example of structural damage in Coalinga caused by the May 2, 1983 earthquake.

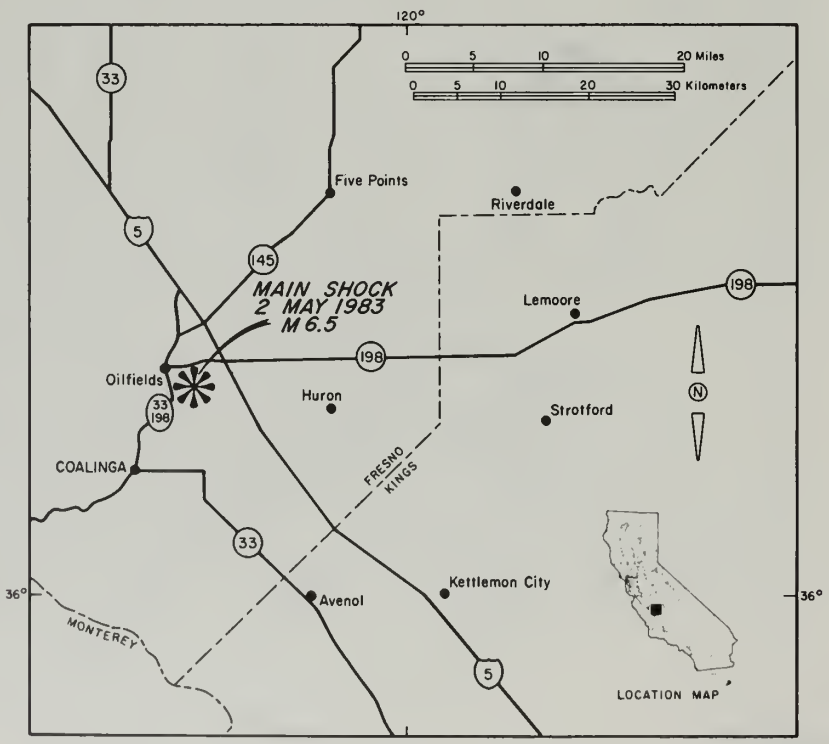

Figure 6. Map showing epicenter of Coalinga earthquake main shock on 2 May 1983.

Coalinga Earthquake Sequence, 2 May 1983. A magnitude 6-1/2 earthquake rocked the western part of the San Joaquin Valley (see Figure 6). This was the largest shock in California since the Mammoth Lakes earthquake sequence of 1980. Although classed as a moderate (M6-7) earthquake, the downtown business district of Coalinga was ravaged (Photo 3): 141 businesses were destroyed and another 73 damaged; 165 houses were destroyed and another 680 damaged. More than 1,000 people were evacuated or displaced, and a few were injured. More than $32 million worth of damage resulted from this earthquake. A special publication on the event is being prepared as a part of the Division's role in the dissemination of information.

In the days following the initial mainshock, Division staff conducted on-site earthquake follow-up studies and participated in the Information Clearinghouse set up in the area to coordinate scientific investigations and to serve as a source to the media and public of the developing scientific understanding of the event.

Earthquake aftershocks have continued in the area. As a result, two faults have been identified: the Nunez fault, which resulted in ground rupture on about 11 June, and the Anticline Ridge fault, which was the source of the main shock. The Anticline Ridge fault did not rupture the ground surface, which is unusual for a California earthquake of M6.

Although earthquake activity is not new to the Coalinga area, the occurrence of a magnitude 6-1/2 event at this location was a surprise to many earth scientists concerned with the seismic safety of California.

Mammoth Lakes/Long Valley. The Division continued its monitoring efforts in the Mammoth Lakes/Long Valley area this year with six-to-eight three-component digital seismograph sites in the caldera. Efforts centered on spectral analysis (frequency distribution) of seismic waves generated by earthquakes on and around the caldera. Similar studies at Mt. St. Helens, Washington, indicate that spectral differences exist between magmatic and non-magmatic transport events which permit prediction of an eruptive volcanic phase. A swarm of M5 earthquakes in January 1983 heightened scientific concern about a possible eruption. CDMG is one of several groups advising the State Office of Emergency Services on the volcanic hazard at Mammoth Lakes.

Southern California Earthquake Preparedness Project. The Division has contributed to preparedness for the next major earthquake in the southern California region by participating in the Southern California Earthquake Preparedness Project (SCEPP), which is jointly funded by the California Seismic Safety Commission (CSSC) and the Federal Emergency Management Agency (FEMA). The broad goal of SCEPP is to reduce potential losses from major earthquakes through improved emergency-response planning. More specifically, SCEPP is aimed at initiating a comprehensive emergency preparedness planning effort for the next great earthquake in the southern California metropolitan area. A 1981 report by FEMA concludes that the chances of a catastrophic earthquake in the southern California area in the next 20 to 30 years exceeds 50 percent, and that losses from such an earthquake could range from 3,000 to 23,000 deaths and $15 billion to $70 billion. To prepare for an event of this scale requires an understanding of the probable geographic distribution of damage and

casualities for anticipated earthquakes, as well as an assessment of the probable performance of specific lifelines during and following such events. To this end, SCEPP plans to provide a regional data base and analysis system for a five-county area that will contain seismic, geologic, structural, and demographic data. Included will be a variety of computer models that will use this data base to forecast severity and distribution of damage and casualties for earthquakes of any specified size or location. CDMG has assisted in this effort through the provision and evaluation of seismic, geologic, and structural data, as well as evaluation of seismic shaking and structural vulnerability models.

Review Activities. Reviews relating to seismology are required to assess the adequacy of seismological data in documents for planning and design considerations of various public projects. Reviews are done in concert with geophysicists and geologists using the most current information and state-of-the-art techniques. In fiscal year 1982-83 the seismic risk aspects of environmental impact reports as well as hospital siting reports were reviewed.

3. Historical earthquakes study

During fiscal year 1982-83 the Division conducted an investigation to define the areas in California that were most damaged by earthquakes during the first half of the twentieth century. The study was funded by the U.S. Geological Survey.

The investigation focused on earthquakes of magnitude 5.5 or greater that caused damage of Intensity VII or greater (Modified Mercalli) in California. From 1900 through 1949, 61 earthquakes meet these criteria. The areas shaken at Intensity V or greater were determined by interpreting the earthquake effects reported in the seismological literature as well as newspaper reports from the damaged areas. About 2,300 newspaper issues were searched; one-third provided earthquake reports. A bibliography of the newspaper issues searched and summaries of the reported effects that were used to determine values of intensity are also included in the open file report. Isoseismal maps showing the areal extent of the areas damaged by the 39 most damaging earthquakes were prepared and published as Open File Report OFR 82-17 SAC.

4. Geophysical studies

The Division conducted a number of geophysical surveys during fiscal year 1982-83. Some of these were in support of geologic projects to help define subsurface structures, and others were primarily geophysical studies. The geophysical data resulting from these studies are used principally to define fault zones, locate mineral deposits, and define favorable areas for geothermal resources.

a. Gravity mapping

Activity continued on the Gravity Maps of California project. The following 1:250,000 scale gravity maps (1 by 2 degree quadrangles) were published this year: revised Santa Cruz (Monterey), Westwood (Susanville),

Chico, Walker Lake, Mariposa, Fresno, Santa Maria, Long Beach, Salton Sea, and San Diego-El Centro. The Sacramento, San Bernardino, and revised Santa Rosa sheets have been drafted and are being reviewed and corrected. In addition, the last sheet, Santa Ana, is in preparation.

b. Aeromagnetic mapping

Preparation of the 1:250,000 scale aeromagnetic map series is continuing. The Santa Rosa and Alturas sheets have been completed, and the Sacramento sheet is nearly complete. The San Francisco - San Jose sheet also is in preparation. The completion of most of the remaining map sheets will depend on the progress of aeromagnetic surveys in the state. An updated aeromagnetic index map of the state has been prepared and will be submitted for publication in CALIFORNIA GEOLOGY magazine.

c. Geophysical projects to support other investigations

Geophysical field and office support for several geothermal investigations and site reviews was provided in the form of magnetic, gravity, seismic refraction, and electrical resistivity surveys and data analyses. The geophysical surveys provided information pertinent to the identification of buried faults and other geologic structures, as well as the determination of local bedrock and water depths, variations in the thickness of subsurface strata, and the magnetic properties, seismic velocities, electrical resistivities and densities of local rock units.

Geothermal studies supported include Department of Energy projects in Paso Robles, Calistoga, San Bernardino, Sonoma, and Bridgeport; California Energy Commission projects at the Sonoma State Hospital, Rohnert Park, and Santa Rosa; and a state-funded project in northern Sonoma Valley.

5. Reservoir induced seismicity investigations

Because earthquakes can sometimes be triggered by the filling or rapid drawdown and refilling of surface reservoirs, the Division of Mines and Geology, with funding from the U.S. Geological Survey, conducted a detailed study of the seismicity surrounding Lake Oroville in Butte County to define the natural seismicity of the area and to determine how it was affected by the filling of the lake in 1968. Lake Oroville was selected in part because a magnitude 5.7 earthquake centered near the lake occurred in 1975 following partial emptying and refilling of the lake. The patterns of spatial and temporal distribution of the Oroville earthquakes were compared to the seasonal variations in reservoir storage to detect any seasonal effects the reservoir might have on the seismicity.

In addition, because earthquakes associated with reservoirs are rare, the Division this year also studied the seismicity near Aswan dam in Egypt; this study is being performed with funds from the U.S. Geological Survey. Patterns of seismicity in relation to water level changes at the Aswan dam were analyzed and compared to the data from Lake Oroville to further understanding of the phenomenon in California. It was found that the 1981-82 Aswan earthquakes,

which are the most recent case of seismicity associated with reservoirs, have a geological setting and a pattern of delay after filling similar to those at Oroville.

The Division's aim in characterizing and documenting cases of reservoir induced seismicity is to understand the nature of the mechanism and to define the circumstances required to trigger earthquakes. This should lead to improved methods of assessment and mitigation of this hazard in California, where reservoirs and faults abound.

6. Cal-Mexico geologic hazards investigation

The Cal-Mexico geologic hazards study was undertaken to identify and integrate understanding of seismic hazards on the California side of the California-Mexico border. Through this program, CDMG is playing a lead role in a collaborative effort involving scientists and technicians of both countries. The purpose of this collaboration is the collection and interpretation of geological, geophysical, and seismological data for the purpose of delineating, describing, predicting, and mitigating seismically related geologic hazards in the border region.

The first step toward attaining these goals was the compilation of existing regional geologic and geophysical data, in order to identify gaps in understanding the regional processes and problem areas for future investigation. The program has produced combined geologic, gravity, aeromagnetic, and seismicity maps of the border region, and a regional earthquake catalog. General discussions of the regional geology and seismicity accompany the respective maps.

During fiscal year 1982-1983, the program also concentrated on understanding aspects of the seismic hazards in the San Diego area. A new seismic station has been installed at Mt. Soledad, within the Rose Canyon fault zone, to help improve accuracy in plotting the locations of local events. Geologic mapping was conducted in the area of the "Tijuana Lineament" to see if a continuation of the San Miguel-Vallecitos fault zone toward San Diego could be found. The improved knowledge of the geology south of San Diego will greatly assist future investigations.

During 1983-1984, the program will use the body of knowledge related to the San Diego area to produce a seismic hazards map of the metropolitan area. Seismic intensities resulting from a hypothetical earthquake on the Rose Canyon fault zone and possible damage to lifelines will be forecast.

I V. Environmental Geology Program

The Environmental Geology Program provides specialized scientific expertise for dealing with a variety of diverse environmental concerns ranging from the potential of geothermal heat as an alternative energy source in Californa to mined-land reclamation assistance and review, and the coordination of volcanic-hazard response and planning activities. Specific areas of program activity are: (1) geothermal resource studies; (2) mined-land reclamation, (3) geochemical studies, and (4) volcanic hazards coordination.

1. Geothermal Resource Studies

CDMG's geothermal resources unit provides the special information and expertise needed to evaluate the potential of specific areas in California for the development and utilization of geothermal energy. In the performance of this service, the Division conducts reconnaissance level as well as in-depth assessment studies of high-temperature and low- and moderate-temperature geothermal resources in the state. While high-temperature geothermal resources can be used to generate electricity, as is being done at The Geysers in Sonoma County, geothermal resources in the moderately hot temperature range, being more widely distributed geographically, offer more opportunities for widespread development and can be developed for such direct applications as the heating of homes, businesses, and public buildings, and for utilization in industrial and agricultural processes. The majority of the Division's geothermal studies have focused on the assessment of geothermal resources in the moderately hot temperature range.

During fiscal year 1982-83, the Division completed a reconnaissance assessment study of 40 selected geothermal sites in the state and three in-depth assessment studies, all under funding from the U.S. Department of Energy (DOE). Progress was made during the year on preparation of the "Technical Map of Geothermal Resources of California," also a DOE-funded project. In addition, under State funding, a major resource assessment study of the northern Sonoma Valley region was carried out during the fiscal year.

Forty-Site Reconnaissance Assessment. The Division selected 40 sites that have potential for geothermal development, as well as 20 alternative sites, for reconnaissance study. The DOE-funded study entailed background research for each site, site visits during which water samples were collected, and subsequent chemical analyses of the thermal waters. A report presenting a geologic description and other pertinent data for each site was released on open file as OFR 83-12 SAC.

Southern Sonoma Valley Assessment. The Division chose the southern Sonoma Valley for study because it is characterized by: (1) a moderately widespread occurrence of geothermal resource indicators; (2) proximity to a large labor force and to agricultural and industrial market places (Santa Rosa and the San Francisco Bay area); (3) good transportation facilities; and (4) interest in geothermal resource development on the part of local government and the private sector. The Division initiated the DOE-funded study during fiscal year 1981-82.

The study included extensive sampling and temperature probes of geothermal wells; resistivity, seismic refraction, magnetic, and gravity surveys; geohydrology studies; and reconnaissance geologic mapping. Also included was a study of the area's seismicity as it relates to geothermal occurrence. A report identifying areas of high potential for development was completed and released on open file as OFR 83-13 SAC.

Bridgeport, Mono County, Assessment. The Division initiated this DOE-funded study during fiscal year 1981-82 to determine the development potential of the geothermal resources in the Bridgeport-Bodi Hills area, Mono County. A model for the hydrothermal system with a potential for supporting thermal wells in the area, geological and geophysical data, and recommendations for further study, including specific sites for test drilling, were developed and presented in a report (OFR 83-14 SAC) released during fiscal year 1982-83.

Paso Robles Assessment. The Division initiated this DOE-funded study during fiscal year 1981-82. Strong interest in developing the resource had been expressed by the municipal government of Paso Robles following an earlier reconnaissance study of the area. An in-depth study that included detailed geophysical and seismological surveys and geochemical analyses of thermal waters was carried out to complete the geological and hydrogeothermal picture and to sharpen definition of the resource. A report that delineates areas of highest development potential and presents the detailed results of the study was completed and released on open file as OFR 83-11 SAC.

Statewide Technical Map of Geothermal Resouces. The Division completed data development and compilation of the "Technical Map of the Geothermal Resources of California," which is being prepared in cooperation with the National Oceanic and Atmospheric Administration (NOAA). The 1:750,000-scale map (4 feet by 5 feet) depicts the statewide distribution of geothermal resources with water chemistry for each occurrence and shows their relation to faults and Quaternary volcanic rocks. A text presenting detailed data on the water chemistry and other characteristics of known thermal wells and springs in the state was also completed in preliminary form. The map and text are planned to be printed and released in 1984.

Northern Sonoma Valley Assessment. The Division initiated this in-depth study under State funding as an extension of its southern Sonoma Valley assessment, described above. The study of the southern part of the valley indicated several patterns, trends, and anomalies that appeared to extend north and northwest in the valley. The study of this northern part of the valley included background research and compilation of existing geologic and geophysical mapping, field mapping, geophysical surveys, chemical analyses of thermal waters, and well-temperature probes. Three main areas where there is potential for geothermal development were identified. A report presenting the results of the study was completed to first-draft stage by the end of the fiscal year.

During the course of this study, CDMG enjoyed cooperative relations with the local governments having jurisdiction in northern Sonoma Valley. Help was received as well as given. After the study was completed CDMG staff members participated in a County-sponsored geothermal workshop held in June 1983 in the city of Sonoma, and presented the results of the study. Keen interest in the

potential for development of the resource was shown by local government and by area residents alike, and the County is investigating ways to further explore and develop the resource.

2. Mined-land reclamation (3rd element of SMARA)

The objective of the mined land reclamation unit is to provide legislatively mandated assistance to local governments in planning for surface mining and reclamation of mined lands.

The Surface Mining and Reclamation Act of 1975 (SMARA), as amended, provides that the State Geologist shall furnish technical assistance in the review of reclamation plans. Successful surface mined-land reclamation planning and implementation in California are achieved through a cooperative approach involving cities and counties, the mineral industry, and the State Department of Conservaton. Cities and counties having mining activities within their jurisdictions have been designated lead agencies under SMARA. Mining operators are responsible under SMARA for the preparation and submission of a reclamation plan prior to the initiation of mining. The reclamation plan includes information on the mining site's characteristics, the commodity, the mining method, the processing requirements, and the specifics of the reclamation program to be undertaken.

Program Facilitation. The multi-disciplinary staff includes expertise in environmental planning, engineering geology, plant ecology/revegetation, and hydrology, with emphasis on surficial processes.

Technical Assistance. Over 320 requests for technical assistance from lead agencies, the mineral industry, and the public were received in fiscal year 1982-83. Many requests for technical assistance by lead agencies included a request for on-site review. Due to funding limitations in 1982-83, only 40 sites were visited. Some site reviews were conducted in cooperation with other State agencies such as the Water Quality Control Boards and the Department of Fish and Game regional staff.

"Surface Mined-Land Reclamation Planning and Implementation in California." Staff is preparing a publication on reclamation planning in California. The publication includes six chapters: (1) the benefits and process of reclamation planning, including integrating operational and reclamation planning, phased reclamation, a systemized process for reclamation plan development, performance assurances, community involvement/public participation, graphic modeling as a tool, and monitoring and maintenance mechanisms; (2) the possibilities and advantages of selecting subsequent uses for reclaimed mined land, including interim uses and the constraints that different mining operations pose; (3) basic surface and groundwater processes, common changes to the hydrologic regionals (both positive and negative) as a result of mining, and the use of reclamation to mitigate impacts and to produce beneficial hydrologic effects; (4) the necessity for sedimentation and erosion control in the reclamation process, the general processes of erosion and specific erosion control measures, with their limitations, and a comparison of erosion control measures and cost effectiveness; (5) the need for and advantages of land shaping as a part of reclamation; and (6) the functions of revegetation modification of mine wastes to improve plant growth, preparation of revegetation plans, and revegetation methods. An annotated bibliography and glossary will also be part of the publication.

Photo 4. Site visit to proposed operation. Operator explaining his operation.

Photo 5. Reclaimed site, Larkspur Landing.

Reclamation Plan Repository/Library. Over 800 reclamation plans are now on file by county in the CDMG Bercut Office, in Sacramento, and will be entered into the SMARA/Minerals Computer Index System. Locations of mines with reclamation plans are being plotted on county maps and will also be available on computerized maps in fiscal year 1983-84

Workshops/Seminars. Staff has worked on the preparation material for several workshops and seminars scheduled in 1983-84. The first is a workshop in cooperation with the California Association of Resource Conservation Districts Annual Convention in Monterey, in November 1983. Other workshops have been planned with the County Planning Commissioners Association and with lead agencies. A policy workshop and an international conference on reclamation are being planned for February and September 1984, respectively; the theme will be "Productive Second Uses of Mined Lands."

3. Geochemical studies

The objective of the geochemistry laboratory unit is to provide geochemical support services primarily to the Division's Mineral Resources Analysis element. The unit also provides support services to other Division programs and carries out independent projects.

Plans for moving the Division's geochemical laboratory to Sacramento in fiscal year 1983-84 were made.

During this year geochemical support was provided to the minerals and geothermal programs. Ninety-six samples from the San Gabriel anorthosite project were analyzed for titanium by x-ray fluorescence. Fifty samples from the zeolite project were analyzed by x-ray diffraction. Work on a statewide saline commodity study was initiated late in the fiscal year.

Work continued on preparation of the 1:750,000 scale Technical Map of Geothermal Resources of California and accompanying text for publication. At the end of the fiscal year final corrections were being made to the map and text.

4. Volcanic hazards coordination

The objective of the volcanic hazards coordination unit is to provide liaison between technical experts of various federal agencies and the State Office of Emergency Services, through the State Geologist, regarding hazards posed by the threat of volcanic eruption in California.

Background. On May 25, 1982, the U.S. Geological Survey issued a notice of potential volcanic hazard for the Mammoth Lakes area in east-central California because of recent changes in earthquake and thermal activity. The Workshop on Volcanic Hazards in California, held December 3-4, 1981, and sponsored by the Department of Conservation's Division of Mines and Geology and the Office of Emergency Services, had identified the Mammoth Lakes area as one of the prime candidates for the next volcanic eruption in California. The Division of Mines and Geology had been monitoring the seismicity of the area since September 1979 following two magnitude 4 events on September 24, 1979.

During fiscal year 1982-83, the major activities associated with volcanic hazards were focused on the Long Valley caldera in the vicinity of Mammoth Lakes, Mono County. CDMG maintained liaison with the U.S. Geological Survey and the Office of Emergency Services. CDMG worked with the Office of Emergency Services on "Plan Caldera - Long Valley Volcanic Hazards Response Plan." Annex A of Plan Caldera was prepared by CDMG, and covers the geology, seismology, and geohydrology phases of the response plan. The role of CDMG in Plan Caldera is to provide timely advice to the Office of Emergency Services in advance of a possible volcanic eruption in the Mammoth Lakes region by maintaining liaison with all the scientists conducting volcanic hazard related studies in the area.

CDMG, in cooperation with the Office of Emergency Services, participated in a series of meetings from January through May 1983 to inform the representatives of local government agencies, the public, and the news media of the potential volcanic hazard and plans for response in the event of an eruption. One concern of some of these meetings was to work out policies for dealing with local government and the public that were compatible with the California Office of Emergency Services, the U.S. Geological Survey, and the California Department of Conservation. An especially important meeting was held in Sacramento on May 19-20, 1983, to discuss the types of volcanic activity possible at Mammoth Lakes in the near future and the practicality of planning for a joint Emergency Operations Center at Bishop, California. This meeting was attended by representatives of CDMG, the Office of Emergency Services, the Nuclear Regulatory Commission, the U.S. Geological Survey, and volcanologists from universities and industry.

Late in the fiscal year plans were made for the establishment of a computorized seismic monitoring system that will enable the real-time detection of anomalous Mammoth Lakes seismicity that may be precursory to volcanic eruption.

Photo 6. View south across Long Valley caldera from hills east of Deadman Summit. Mt. Morrison is the sharp peak on skyline on the right. The floor of Long Valley is on left center. Photo by John Burnett.

V. Geologic Investigations Program

The Geologic Investigations Program provides both basic and applied geologic information--primarily, but not solely, in the form of maps. This information is used in mineral resource development, in land-use planning and regulation by local government, in timber harvest planning, in development-site evaluation studies, and in other endeavors requiring sound information on the geology of the state. The specific areas of program activity are (1) fault evaluation and zoning, (2) regional geologic mapping, (3) forest watersheds mapping and timber harvest plan review, and (4) subsurface investigations.

1. Fault evaluation and zoning

The Division's fault evaluation and zoning unit was established by the Alquist-Priolo Special Studies Zones Act (APSSZ) of 1972 (Public Resources Code, Division 2, Chapter 7.5). The objective of the law is to provide for the public safety from surface rupture in hazardous fault zones by restricting construction astride active fault breaks.

Under the APSSZ Act, the State Geologist delineates Special Studies Zones about one-quarter mile wide along potentially hazardous faults, including the San Andreas, Calaveras, Hayward, and San Jacinto faults. Under guidelines adopted by the State Mining and Geology Board, local governments permit certain development projects in the Special Studies Zones only after geologic studies show building sites to be free from hazardous faults. Generally, structures for human occupancy are not permitted within 50 feet of an identified trace of an active fault.

The Special Studies Zones (SSZ) maps delineate areas along active fault breaks found to be potentially hazardous because of possible surface rupture. These maps are drawn at a relatively large scale (one inch equals 2,000 feet) to assure that the boundaries of the zones are adequately displayed for land-use regulatory purposes.

The four major faults named in the Act--the San Andreas, the Calaveras, the Hayward, and the San Jacinto faults--were initially zoned on the basis of available existing data. When the zonation of other faults "sufficiently active and well-defined" (PRC, Sec. 2622) was begun, it became apparent that in many cases the available data were not sufficient for the purpose of zonation. In recognition of this insufficiency of data and the large number of potentially active faults in California that needed to be evaluated for possible zonation, in 1976 a Fault Mapping and Evaluation Program, with scheduled regional evaluations including field mapping and detailed interpretation of aerial photographs by CDMG staff, was initiated as an augmentation of Special Studies Zones mapping unit. At this time, in addition, the criteria for zonation were refined based upon the Divison's zoning experience up to that time. Besides carrying out scheduled evaluations of specific regions of the state, the unit also evaluates previously zoned faults for possible revision or deletion when taking another look is warranted by new data. The Division's Fault Evaluation and Zoning Program is described fully in the recently revised Special Publication 42, "Fault-Rupture Hazard Zones in California."

Figure 7 shows regions in the state scheduled for evaluation, including those whose evaluation has been completed, and the principal faults in California that have been zoned under the Alquist-Priolo Act.

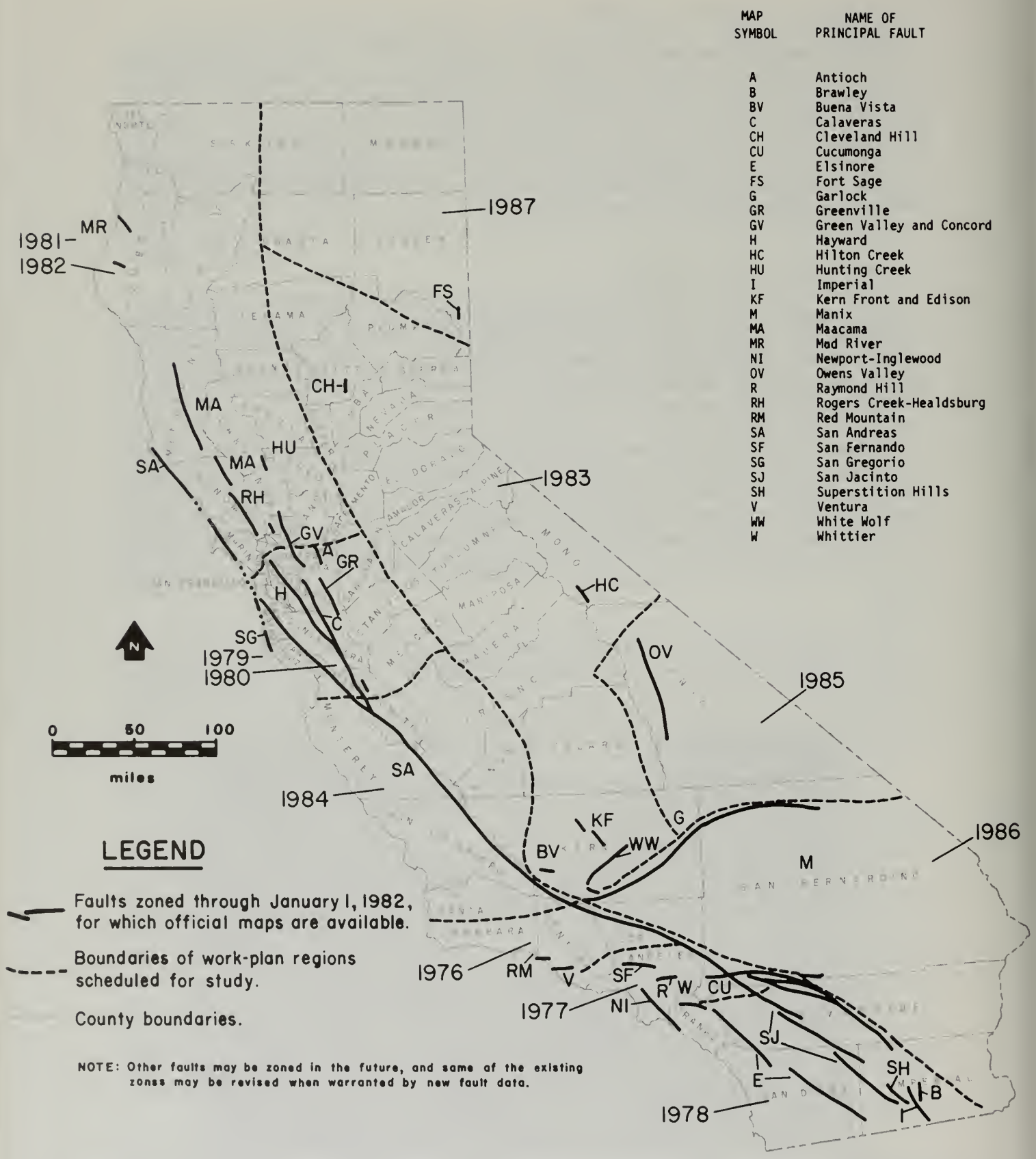

Figure 7. Principal faults in California zoned for special studies under the Alquist-Priolo Special Studies Zones Act of 1972. Dashed lines and dates identify work-plan and priorities for studying areas under the Fault Evaluation and Zoning Program, 1976 to 1987.

During fiscal year 1982-83, the Alquist-Priolo Program completed an 18-month study of the northern Coast Ranges, and field work commenced in a new study area along both sides of the Sierra Nevada. The present report will emphasize the completed work in the northern Coast Ranges.

The faults evaluated in the northern Coast Ranges region include all or portions of the Rodgers Creek-Healdsburg fault in Sonoma County, the Maacama fault in Sonoma and Mendocino counties, the Green Valley fault in Solona and Napa counties, Mad River fault in Humboldt County, and many other active and potentially active faults. Areas having faults recommended for new or revised zoning under the APSSZ Act are identified on Figure 8. Time did not permit the evaluation of some existing SSZ's in the study area (mainly for the San Andreas fault), but these zones are considered functional and adequate. The lack of time also prevented formal evaluation of certain previously unzoned faults (such as the Burdell Mountain and Bartlett Springs faults), although a preliminary analysis indicated that these faults either do not constitute a significant ground-rupture hazard or lie in areas having little or no development.

New Special Studies Zones were recommended for segments of the Maacama, Green Valley, West Napa, Cordelia, Hunting Creek, Konocti Bay, Trinidad, McKinleyville, Fickle Hill, and Goose Lake faults. All or parts of the Rodgers Creek, Healdsburg, and Green Valley faults were recommended for zone revisions, mainly by narrowing the existing zones to include only those faults strands considered to be Holocene-active and well-defined.

Previously zoned faults that do not meet the present zoning criteria were recommended for deletion and withdrawal of the existing SSZ's. These include the Tolay, Alexander, Chianti, and minor unnamed faults, as well as segments of the Maacama fault in Sonoma County.

Altogether 30 Official Maps of Special Studies Zones were issued on July 1, 1983. Of these, 18 maps are new and 12 maps are revisions of Official Maps issued in 1974 and 1976. The Official Maps affected seven counties and four cities. In addition, the cities of Healdsburg and Rohnert Park are no longer affected by the Special Studies Zones.

Other faults that were evaluated and not recommended for zoning were the Little Salmon-Yager, Big Lagoon, Grogan, and other faults, as well as segments of the Cordelia, West Napa, and certain other faults. These faults and fault segments were not previously zoned.

In summary, CDMG's fault evaluation studies in the northern Coast Ranges reveal that all or parts of about 15 faults were sufficiently active (Holocene) and well-defined to warrant zoning under the APSSZ Act. Fiscal year 1982-83 work is summarized in Open-File Report OFR 83-10 SF.

In addition to evaluating and zoning faults, other functions of the Division under the Alquist-Priolo Special Studies Zones Act include: (1) the filing of geologic reports for development sites within the Special Studies Zones; and (2) review of waiver requests in lieu of a geologic report as provided for in PRC, Sec. 2623. By the end of the 1982-83 fiscal year, a total of 1,539 geologic reports were on file and available for public reference at the San Francisco regional

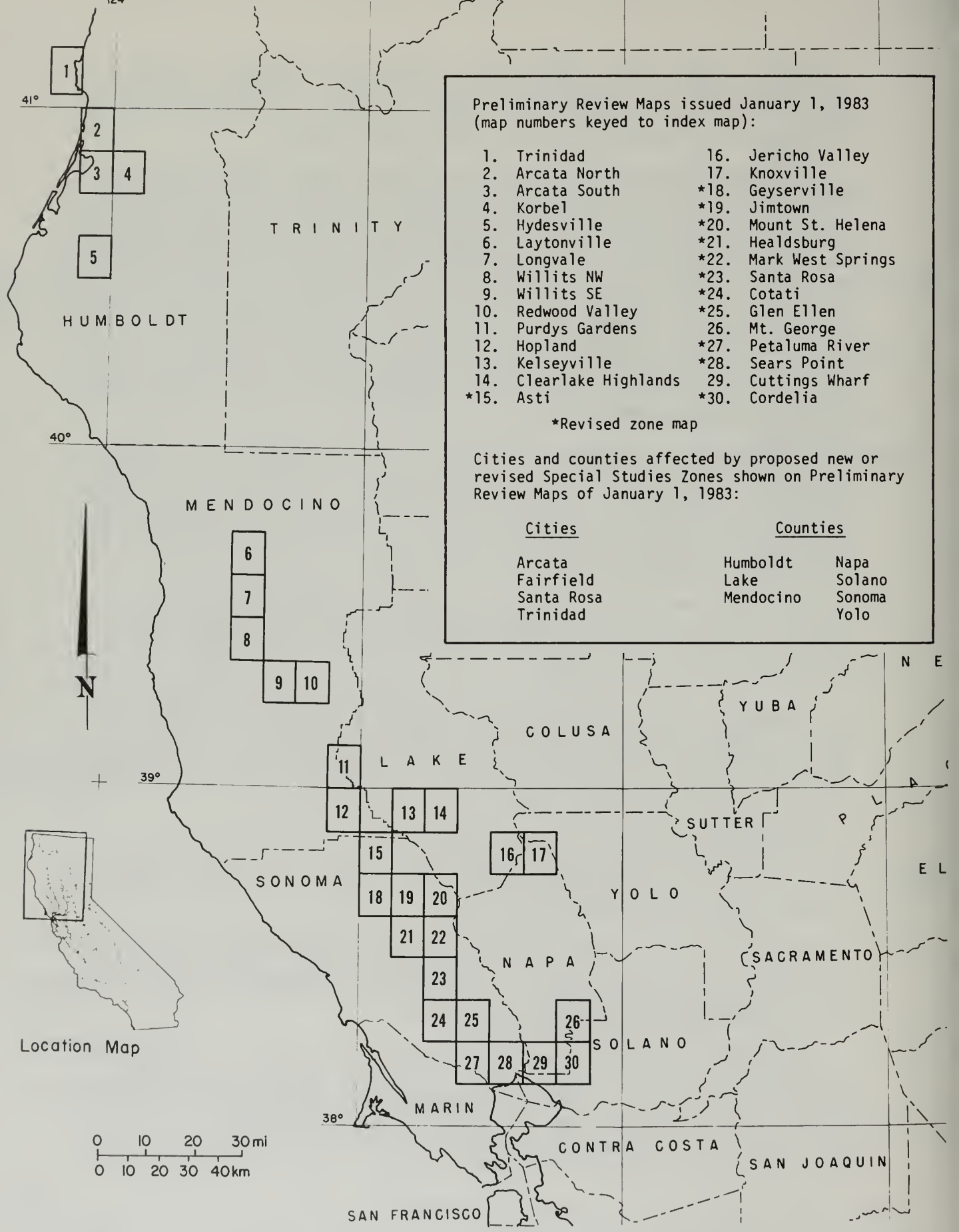

Figure 8. Preliminary Review Maps of proposed new and revised Special-Studies Zones issued January 1, 1983 pursuant to the Alquist Priolo Special Studies Zones Act.

office. An index map, Open-File Report OFR 76-6 SF (last revised in 1979), identifies the sites investigated for faults under the Act. No waiver requests were submitted during fiscal year 1982-83; there have been 67 previous requests since 1974.

Finally, an important activity of the program staff is to provide information about the Alquist-Priolo Act, CDMG's fault zoning and evaluation program, and fault-rupture hazards to both the public and private sectors. It is estimated that the program staff spent 15 to 20 percent of their time responding to hundreds of inquiries by geologists, planners, building officials, realtors, developers, financial institutions, and others.

2. Regional geologic mapping

The Regional Geologic Mapping Program was established to prepare and maintain a baseline source of state-of-the-art geotechnical information on the geologic and seismologic framework of California. CDMG staff scientists produce regional quadrangle maps (mostly 1 degree by 2 degrees in area, at a scale of 1:250,000) by compiling geological, geophysical, and seismological data obtained from CDMG field work and photo interpretation, and from other geoscientists from State and Federal government, universities, and private sector sources. The maps are used by government agencies at all levels and by the private sector. The information on the maps is used in mineral resource appraisals, geologic hazard assessments, and site-specific geologic investigations needed for major development and construction projects.

The new series was initiated in 1978 because most State Atlas sheets, also at 1:250,00-0 scale, were 15 to 20 years old and considerable new geologic mapping had been accomplished since they were published.

The pilot map in the Regional Geologic Map Series was the Sacramento Quadrangle. Although the field work and compilation were completed in 1979, publication was not completed until fiscal year 1982-83. This full-color map was put on sale in December 1982, and has proved to be a very popular map with a wide range of users. Because the map straddles a large part of the Mother Lode belt, it is of particular interest to gold seekers, both professional and amateur.

The second sheet in the series, Map 2A, is the Santa Rosa Quadrangle. By the end of the fiscal year it had been printed and was nearly ready for release (subsequently released September 28, 1983). The original Santa Rosa geologic atlas sheet was published in 1963. Considerable new data amassed during the past 20 years was used in the new compilation. Areas where geologic mapping was lacking or inadequate lie in the northwestern and northeastern parts of the quadrangle; field mapping was undertaken by the Division to upgrade these areas.

The Coast Ranges shown on this map is laced with a large number of active and potentially-active faults, including the San Andreas, Rodgers Creek-Healdsburg, Maacama, Green Valley, Collayami, and other related faults. This area of badly broken rocks naturally has a propensity for sliding, and the new map, therefore, shows areas where larger landslides occur.

Evaluation of mineral resources potential in the area will benefit from this graphic synthesis of geologic data. The map shows host rocks and structure relationships pertinent to an understanding of ore deposition. Such data should be useful in exploring for concealed deposits and in planning programs such as CDMG's urban and nonurban mineral land classification (SMARA). The large deposit of low-grade, disseminated gold discovered by Homestake Mining Company lies within this quadrangle. Other mineral resources of the area include mercury, chromite, pumice, and perlite.

Like the 1981 Sacramento Quadrangle, the new 1982 Santa Rosa Quadrangle comprises several sheets. These include: (1) a colored geologic map and cross sections; (2) a source data index sheet; (3) a detailed geologic legend; (4) a sheet showing both the location of rocks that have been dated by radiometric methods and the location of thermal springs and wells; and (5) a fault map that distinguishes recency of fault activity by use of different colors. The topographic base on which the former Santa Rosa atlas sheet was published is now 24 years out of date. Updating the geology on the more modern topographic base makes the map much more useful, and will enable one to locate and relate the geology and faults more accurately and quickly.

Compilation of a new San Bernardino Quadrangle was completed in June 1983. It includes significant new field data from seven projects that were supported by the Data Base Augmentation Program. The large amount of new information that had become available since publication of the earlier San Bernardino map was incorporated in the compilation. The recent recognition and correlation of Great Basin stratigraphy in this area is portrayed by the new geologic legend especially designed for this sheet; it includes some 89 formational or rock units, compared to the 54 State Map Sheet units portrayed on the earlier edition.

The San Bernardino Quadrangle depicts a number of major faults including all or parts of the San Andreas, San Jacinto, Cucamonga, Helendale, Pinto Mountain, Manix, Lenwood, Calico, Camp Rock, Emerson Lake, and Pisgah faults. The quadrangle area is also highly mineralized; it contains a vast number of active mines and known deposits of gold, silver, limestone, hectorite, strontium, copper, pumice, salines, iron, lead, and uranium.

Compilation of the Weed Quadrangle in northern California was completed in June 1983. The earlier 1964 edition of this map was based largely upon reconnaissance work. During the past 19 years, a great wealth of new mapping was acquired; this was supplemented by ten projects supported by the Data Base Augmentation Program. In addition, considerable new data was acquired from the field work of five experienced volunteers (including three professors), several years of U.S. Geological Survey work in wilderness areas, and the detailed reconnaissance mapping done by the Regional Geologic Mapping staff. Work during fiscal year 1982-83 revealed several surprises even in the gross distribution of the principal rock types, such as missing plutons and nonexistent ultramafic sheets. Mineral resources of the Weed quadrangle area include placer and lode gold, chromite, mercury, volcanic cinders, nickel, cobalt, and barite.

Compilation of the second regional geologic map in southern California, the Trona-Kingman Quadrangle, was initiated early in the fiscal year. This map includes all of the 1° x 2° Trona quadrangle and that portion of the adjacent Kingman quadrangle in California. The area comprises a large part of the northern Mojave Desert Province and parts of the Basin Ranges and Sierra Nevada provinces. The earlier atlas sheets covering this area were published 21 and 22 years ago. Since then much of the area has been geologically mapped in considerably more detail. Substantial field work is being done by the compilers to fill in gaps and upgrade areas where earlier work was done by rapid reconnaissance. The area contains a number of major active or potentially-active faults, including the Garlock, Southern Death Valley, Sierra Nevada, Panamint Valley, Blackwater, Harper, and Lockhart faults. The map also includes two very recent volcanic centers--the Coso and Kelso areas, each comprising many cinder cones. The Trona-Kingman Quadrangle is also a highly mineralized area with numerous mines and prospects for gold, silver, borax and saline deposits, talc, rare-earth metals, tungsten, lead, iron, and limestone.

A revised Five-Year Plan for the preparation of 1:250,000-scale map sheets was prepared in July 1983. A graphic display of the sheets completed, underway, and proposed is shown in Figure 9.

a. Data base augmentation program

The Data Base Augmentation Program was terminated in fiscal year 1982-83 because of budgetary cut-backs. It was a highly cost-effective program for acquiring basic geologic mapping in critical areas of the state, especially in areas where new regional geologic maps are being prepared by the staff. The program contracted graduate students and professors on a competitive basis. The principal selection criteria was that the geologic mapping was located in geographic areas of highest priority and in areas where no adequate mapping existed.

Although no new contracts were let in fiscal year 1982-83, seven previously committed contracts were completed and geologic maps and reports were delivered. These included three areas on the Weed quadrangle and two areas on the Trona quadrangle.

The program was unusually cost effective. The geologic mapping acquired through the Data Base Augmentation Program cost the State about $32 per square mile. By comparison, equivalent geologic mapping, performed by State or Federal professional geologists, costs between $100 and $200 per square mile.

b. Indices to basic geologic information

Guides to the literature containing basic geologic mapping are essential, not only to the Division, but also for the private sector. Over the years, the Division has prepared and published indices to areal geologic maps of California and to graduate theses on California geology.

Index to published geologic maps of California. Special Report 130, published in 1977, was the last complete index to geologic maps of California. It covered the years 1969-1975. An abbreviated index to 1976 maps was published in the April 1981 issue of CALIFORNIA GEOLOGY

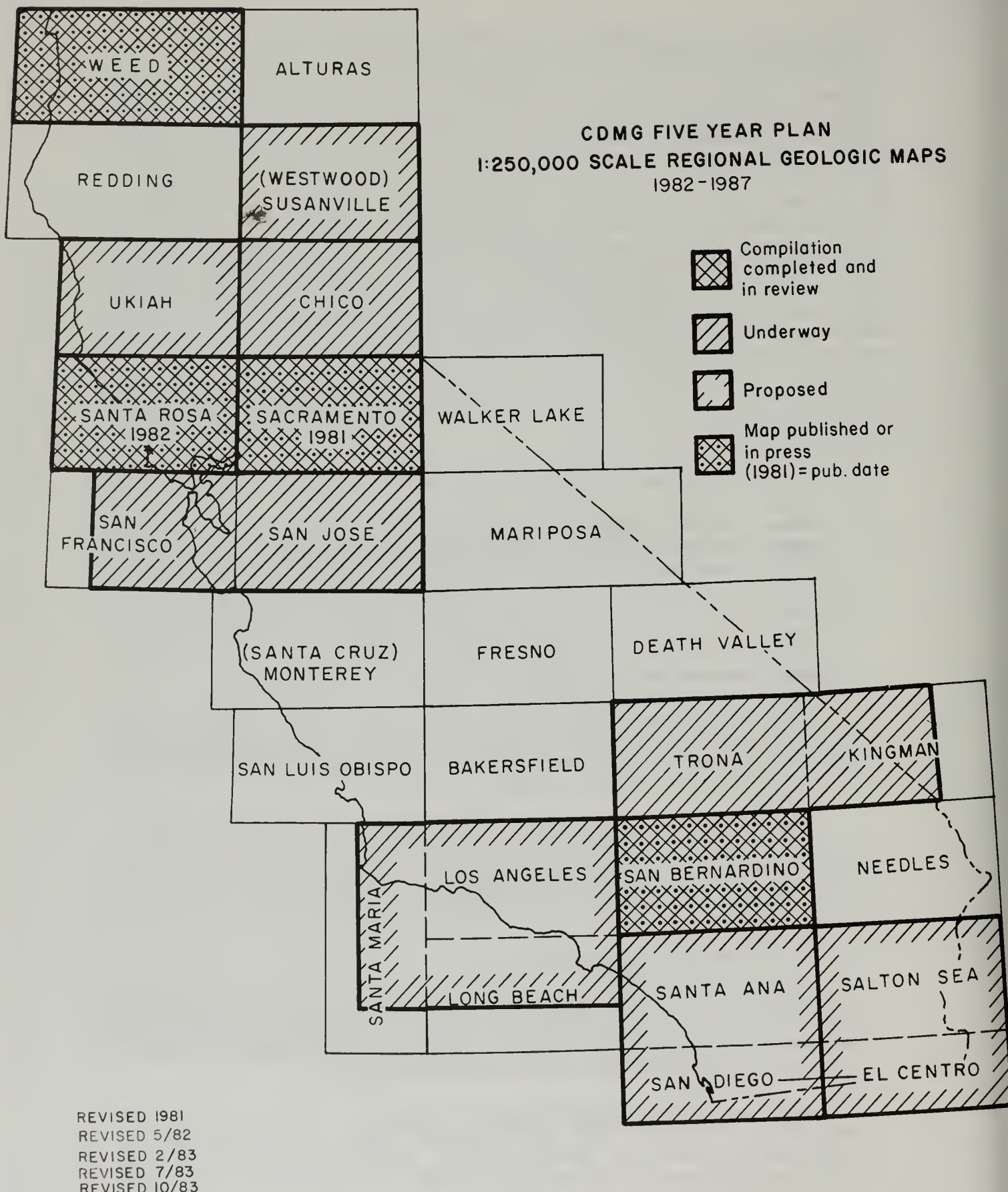

Figure 9. Status of the Regional Geologic Mapping Program.

magazine and another index of 1977-78 maps was published in the January 1983 issue. Because of other priorities and manpower shortages, no sytematic indexing is currently underway, although the need is still present.

Indices to graduate theses on California geology. Geologic maps contained in doctoral dissertations and master's theses are often the most detailed mapping available for various areas of the state. The Division has published two major indices to graduate theses on California geology, Special Reports 74 and 115. The latter report, published in 1974, identifies maps for the years 1962 through 1972. Since then, supplements have been published in our CALIFORNIA GEOLOGY magazine, the latest in July 1980. This report listed theses for 1977 and 1978. Incomplete, unpublished files were prepared for 1979 through 1981, but at present the indexing has not been kept up to date because of manpower shortage.

Bulletin 201 is an explanatory text to accompany the Fault and Geologic Maps of California, scale 1:750,000. The bulletin is scheduled for publication in the winter of 1984.

The bulletin has three parts. Part I focuses on the Fault Map of California, and among several topics it dicusses the evolution of California fault maps, the fault classification used, various fault structures found in the state, fault patterns, major structural blocks and sub-blocks, and fault geometry. It also cautions on the use of the Fault Map of California, Volcanoes, Thermal Springs and Thermal Wells. Part II discusses the Geologic Map of California, including the history of geologic maps of California and a description of the objectives and uses of this map. It also contains an account of the compilation methods used, how the rock units were classified, and special compilation problems. Part III consists of four sections: (1) an index to fault names; (2) a tabulated list of thermal springs and thermal wells; (3) an index to geologic formations; and (4) a detailed map index to the source data used in preparation of the 1:750,000 scale Fault and Geologic Maps of California.

3. Forest watersheds mapping and timber harvest plan review

During fiscal year 1982-83 there were four concurrent Division programs that applied the principles of geology to timber management: (1) Environmental Protection Agency (EPA) watersheds mapping for the California Department of Forestry (CDF), (2) watersheds mapping for the Department of Parks and Recreation, (3) CDF watersheds mapping, and (4) geologic review of Timber Harvest Plans. The goal of all four of these is to gather and interpret data on the nature and extent of geologic units present in key forested watersheds of the northern Coast Ranges, and to make this information available on geologic maps of selected 7 1/2-minute quadrangles. The maps emphasize the surficial units present and the relative hazard of each geologic and soil unit, with the object of correlating their physical characteristics with their local potential for landslides, hillside erosion, and stream-bank erosion. The logging industry and others who use the forest lands as well as forest-land managers and planners are the primary users of the maps.

Four of the Division staff were located in the CDF Santa Rosa office, one was located in the CDF Eureka office, and three were located in the CDMG Ferry Building office in San Francisco.

Using federal funds from the EPA, the CDF contracted with CDMG to prepare interpretative geologic maps of selected areas in the northern Coast Ranges. By the end of fiscal year 1982-83, staff geologists completed mapping the following 7.5-minute quadrangles: Smith River, High Divide, Crescent City, Hiouchi, Scotia, Bull Creek, Weott, Redcrest, Bridgeville, Myers Flat, Fort Bragg, Mendocino, Glenblair NE, Glenblair NW, Glenblair SE, and Glenblair SW. In addition, CDMG, in consultation with CDF and the Watersheds Mapping Steering Committee, prepared interpretive hazard legends describing factors affecting landslide potential and management guidelines for each landslide-related classification. A detailed article describing the watersheds mapping program in northern California appeared in the July 1983 issue of CALIFORNIA GEOLOGY.

The watersheds mapping contract with the California Department of Parks and Recreation called for two additional maps like the ones done for the CDF. These were the Miranda and Garberville quadrangles, which were completed by the end of fiscal year 1982-83.

The Division entered into another three year contract with CDF to do watersheds mapping during fiscal years 1982-85. Approximately fifty 7.5-minute quadrangles in the northern Coast Ranges are planned.

Under the CDF/CDMG Timber Harvesting Plan review contract, Division staff geologists perform the following tasks: (1) screen incoming Timber Harvest Plans (THP's) for geologic review; (2) provide geologic input for the review of THP's; (3) reinspect THP's to evaluate mitigative measures recommended during preharvest inspections; (4) provide assistance in the preparation of training classes for professional foresters who are providing CDF inspections; and (5) provide advice in CDF on issues involving geology, such as changes in Forest Practice Rules, chaparral management, and silviculture methods. During fiscal year 1982-83, there were 2.5 geologist positions assigned to the THP Program. Roughly 200 geologic reviews of Timber Harvest Plans were completed in fiscal year 1982-83.

4. Subsurface data collection

COSUNA. This acronym stands for the Correlation of Stratigraphic Units of North America, a project started by Professor Orlo E. Childs of Texas Technical University and sponsored by the American Association of Petroleum Geologists (AAPG). The main objective of the project is to publish a set or sets of columnar stratigraphic sections that are representative of the geology within the many geologic provinces of the United States. CDMG played a coordinating role in the part of this project that involves California.

California was divided into 14 onshore and 3 offshore provinces. A total of 88 new stratigraphic columns were prepared for publication by AAPG. This landmark project is a major synthesis and compilation of all stratigraphic units found in California. It is a significant contribution to the regional geology of the state and will be widely used during the next decade by exploration petroleum geologists, the private sector, and academia.

California Well Sample Repository. CDMG continued its participation in the advisory guidance of the California Well Sample Repository, which is located on the campus of California State University, Bakersfield. The Repository is the first public facility of its kind in California and fulfills a long-recognized need to assemble, process, preserve, catalog, and make available for public investigative use, a collection of rock samples representative of the geologic history, stratigraphic sequences, rock properties, and mineral resources of the state of California.

The Repository presently contains cores and ditch samples from more than 8,000 oil and gas wells located throughout the state and its offshore areas. Additionally, other materials available for investigative use include foundation boring samples from various major engineering projects, examination slides processed for microfauna from over 850 California wells and 214 outcrop localities, and rock-sample material from Division investigations. An annual catalog of the contents of the Repository is distributed upon request.

The Repository is operated by the California State University, Bakersfield, Foundation, with the guidance and support of an Advisory Committee composed of representatives from the petroleum industry, professional scientific societies, institutions of higher education and State government. The Division is represented on the Advisory Committee.

Photo 7. Volcanic flows and tuff in Cady Mountains in area covered by the San Bernardino 1:250,000 scale Regional Geologic Map. Photo by Edward Bortugno, 1981.

VI. Geologic Information Program

The Geologic Information Program makes information prepared by Division program activities and other pertinent geologic information available to the general public, including local government, the scientific community, and the public at large. The products of all Division investigations are reviewed by the publications staff, the State Geologist, and the Department of Conservation before being released to the public and/or contracting agency. The program also provides technical review of siting reports for certain proposed developoments within the state. Specific areas of program activity are (1) information and publications sales, (2) publications production, (3) earth science library, (4) mineral exhibit, and (5) siting report review.

1. Information service and publications sales

An information service and sales desk is maintained at each of the Division's three regional offices (in the Ferry Building in San Francisco, at the 2815 "O" Street office in Sacramento, and at the 107 South Broadway office in Los Angeles). Thousands of inquiries are received at each of these offices annually. Many questions can be answered by supplying copies of CDMG Notes or particular issues of CALIFORNIA GEOLOGY. Members of the scientific staff are available to respond to specific technical questions that require the application of specialized professional judgment to answer. For some inquiries an individual letter from a member of the Division's technical staff is warranted.

Division publications are sold over-the-counter at these three regional offices, and are available for mail-order purchase from: CDMG, P.O. Box 2980, Sacramento, CA 95812. Order prices for individual publications are given in the Division's current "List of Available Publications." Revenue from the sale of Division publications during fiscal year 1982-83 amounted to $131,823.

At the time a new Division publication is released to the public, copies of it are supplied to all "complete depository" libraries in the state, including the State Library, all University of California campus libraries, certain State University campus libraries, and the municipal library systems of Los Angeles, San Diego, San Francisco, and Oakland. Complete depository libraries therefore should have in-print and out-of-print CDMG publications.

2. Publications production

Information about the geology, mineral resources, and geologic hazards of California is published by the Division and distributed to professionals and interested lay-persons. The results of studies made by scientific staff members of the Division and others in the earth science professions are published in CALIFORNIA GEOLOGY, the Division's monthly magazine, and in bulletins, special reports, special publications, preliminary reports, map sheets, geologic maps, and special information pamphlets called CDMG Notes. News releases concerning the Division's publications and activities are prepared and distributed to the media.

In producing these publications, the publications staff reviews the technical content of manuscripts, edits manuscripts and maps, drafts illustrations and maps, does graphic design and layout of all publications, coordinates printing and lithography, negotiates printing contracts, and manages the printing budget.

a. New publications released

Special Publication 59. Proceedings of Mined Land Reclamation Workshop. Edited by Perry Y. Amimoto. 1982. $9.50. On June 11-12, 1980, the Department of Conservation, Division of Mines and Geology, and the State Mining and Geology Board sponsored a workshop to explore the planning, administrative, technical, and legal aspects of mined land reclamation. Seventeen speakers having a wide range of experience in reclamation projects conducted throughout the United States participated. Topics covered by the workshop presentations included: (1) preparation of reclamation plans; (2) reclamation of sand and gravel mining and rock quarries; (3) in-stream mining; (4) revegetation; (5) planning design and management of the visual resources; and (6) bonding.

Special Publication 61. Earthquake planning scenario for a magnitude 8.3 earthquake on the San Andreas fault in the San Francisco Bay area. By James F. Davis, John H. Bennett, Glenn A. Borchardt, James E. Kahle, Salem J. Rice, and Michael P. Silva. 128 p., 16 maps. $6.00. This scenario portrays anticipated damage to the highway, airport, railway, marine, communication, water, waste disposal, electrical power, natural gas, and petroleum lifelines that service the San Francisco Bay area when it is subjected to the large (magnitude 8.3) earthquake expected to take place during the lifetime of current residents. Most of the lifelines will experience significant adverse effects. Coping with each of these results, taken alone, would require a major emergency-response effort. The combined impacts of all the lifelines being simultaneously impaired by the scenario earthquake will greatly escalate the problem. The added strain of dealing with the expected 3,000 to 11,000 dead and with 12,000 to 44,000 casualties requiring hospitalization resulting from this earthquake will put an unprecedented demand upon government institutions, utilities, businesses, individuals, and society in general. The circumstances will be catastrophic. The information presented in this report is intended to be a basis for planning and preparedness.

Special Publication 62. Proceedings - Conference on Earthquake Hazards in the Eastern San Francisco Bay Area. Edited by E.W. Hart, S.E. Hirschfield, and S.S. Schulz. 1982. $16.00. The conference on earthquake hazards in the eastern San Francisco Bay area was held on the campus of the California State University at Hayward during March 24-27, 1982. The purpose was to bring together earth scientists, engineers, planners and officials from local governments, and other interested specialists to exchange technical information on recent studies and programs directed at the delineation and mitigation of seismic hazards within highly populated bay areas. The three full days of intense exchange included the presentation and discussion of 61 papers, of which about two-thirds are included in this volume, as well as a one-hour panel presentation on the "Seismic Safety Elements."

Special Publication 63. Proceedings of a Workshop on Volcanic Hazards in California. Status of Volcanic Prediction Techniques and Emergency Response Capabilities. Edited by R.C. Martin and J.F. Davis. 1983. $7.00. The country's leading volcanologists and emergency response leaders convened in Sacramento on December 3-4, 1981, to define and discuss the threat of volcanic activity in California, and the methods and state of preparedness to mitigate loss of life and destruction that could result from future eruptions in California. The primary theme of the workshop was the state of volcanic prediction research, and methods applicable to the varied volcanic environments in California. The proceedings volume records each paper presented, the discussion of participants, and formal panel discussions on volcanologic knowledge and human response lessons learned at Mount St. Helens.

Special Publication 64. Processed Data From the San Juan Bautista 101/156 Separation Bridge and the San Juan Bautista Freefield Records from the Coyote Lake Earthquake, 6 August 1979. By L.D. Porter, A.G. Brady, P.N. Mor, and V. Perez. 1983. $6.00. This report contains summaries and plots of uncorrected accelerograms, corrected readings of acceleration, velocity and displacement, and fourier and response spectra of the response to the earthquake.

Special Report 143, Part IV. Mineral Land Classification of the Greater Los Angeles Area: Part IV, Classification of sand and gravel resource areas, San Gabriel Valley Production-Consumption Region. By S.L. Kohler, R.C. Loyd, and T.P. Anderson. 1982. $7.50. Land in the San Gabriel Valley Production-Consumption Region of the Greater Los Angeles metropolitan area has been classified according to the presence or absence of sand and gravel deposits suitable for use in construction grade aggregate. The classified area is depicted on 20 topographic quadrangle maps included in the report. The areas where adequate information indicates that significant mineral deposits are present are classified as MRZ-2.

Special Report 154. Catalog of Strong Motion Accelerograph Records Recovered by the Office of Strong Motion Studies before January 1, 1982. By Office of Strong Motion Studies, under the direction of T.M. Wootton. This catalog consists of entries for SMIP strong-motion records recovered from January 1, 1977, through the end of 1981. Each entry in the catalog presents an identification number for each record along with pertinent information about it, such as the name of the station, its latitude and longitude, the date and time the recording instrument was triggered, and the maximum acceleration recorded. The catalog will be updated as new records are recovered, and new entries will be sent to requesters.

Special Report 152. Slope Stability and Geology of the Baldwin Hills, Los Angeles County, California. By E.Y. Hsu, R.B. Saul, S.S. Tan, J.A. Treiman, and F.H. Weber, Jr. 1982. $10.00. Two plates, scale 1:48,000; 93 pages. This report represents an area-specific study of a serious slope failure problem common to many highly populated or developing areas of coastal California. The report makes use of in-depth understanding and provides detailed recommendations for mitigation of the slope failure problem in this specific problem area.

Special Report 154, Supplement A. Catalog of Strong-Motion Accelerograph Records Recovered by the Office of Strong Motion Studies during 1982. By the Office of Strong Motion Studies under the direction of T.M. Wootton. 1983.

$1.00. 7 pages. This report is the first of a series of annual supplements to the Division of Mines and Geology Special Report 154. Each annual supplement adds entries of records recovered during the prior calendar year.

Seventy-Fourth Report of the State Geologist (1980-82). No charge.

Chico Gravity 1° by 2° sheet, by H.W. Oliver, S.L. Robbins, W.L. Rambo, and R.F. Sikora.

Fresno Gravity 1° by 2° sheet, by H.W. Oliver, and S.L. Robbins.

Mariposa Gravity 1° by 2° sheet, by H.W. Oliver, and S.L. Robbins.

Salton Sea Gravity 1° by 2° sheet, by S. Biehler, and Y. Rotstein.

San Diego - El Centro Gravity 1° by 2° sheet, by S. Biehler.

Santa Maria Gravity 1° by 2° sheet, by J.D. Rietman, and L.A. Beyer.

Walker Lake Gravity 1° by 2° sheet, by H.W. Oliver, D. Plouff, and S.L. Robbins.

Westwood (Susanville) Gravity 1° by 2° sheet, by H.W. Oliver, S.L. Robbins and A. Griscom.

Geologic Data Map No. 1 (REPRINT). Fault Map of California, with locations of volcanoes, thermal springs, and thermal wells. Scale 1:750,000.

b. CALIFORNIA GEOLOGY

Articles published in the monthly earth science magazine were:

Landslides and Flooding Conference
Landslide and Storm Damage, January 1982
Love Creek Landslide Disaster
Flooding and Slope Failure, Santa Cruz County
Lawsuits and Claims Mount
Volcano for Sale
Gravity, Structure, and Geothermal Resources of the Calistoga Area
Mammoth Lakes/Long Valley Microearthquake Project
The Valley Springs Formation in the Sonora Pass Region
Potassium-Argon Dates and Stratigraphy of Pliocene Volcanic Domes near Mokelumne Hill, Calaveras County
Newberry Volcano, Oregon
Mammoth Lakes Volcanic Hazards Workshop
Phorcalite
Reservoir-Induced Earthquake and Engineering Policy
Survey of Building Structures of the Sierran Gold Belt - I
Sand and Gravel from the Outer Continental Shelf
Mount Ian Campbell
Tufa Formation at Mono Lake, California
Artesian Water Wells
Index to Geologic Maps: 1977-1978
AESE Conference

A Pleistocene Diatomaceous Clay and a Pumaceous Ash
Parkfield Strong-Motion Array
Geobotany - Aid to Geologic Mapping
Construction Aggregate Resources, Western San Diego County
Geodetic Surveys on the Foothills Fault System near Smartville, Yuba County
50 Years Ago - Long Beach Earthquake
Forecasting Southern California Earthquakes
Deep Sea Drilling Project
Survey of Building Structures of the Sierran Gold Belt - II
The Calico Early Man Site, San Bernardino County, California
Ancient Volcanic Features of the Berkeley Hills
California's Hazardous Structure Problem
Volcanic Formations along the Klamath River near Copco Lake, Siskiyou County
Survey of Building Structures of the Sierran Gold Belt - III
Significant Earthquakes, 1982
Vernal Pools
Localization of Gold in Quartz Veins
Survey of Building Structures of the Sierran Gold Belt - IV
Coalinga Earthquake
Watersheds Mapping in Northern California
Seismic Safety at the Local Level: Does Planning Make a Difference?

c. Open-File Reports

Reports of Division investigations are released on open-file to make the data available as soon as possible after the studies are completed. This enables interested professional geologists and other users to obtain the data prior to formal publication. The following reports were released on open-file during fiscal year 1982-83:

LOS ANGELES REGIONAL OFFICE

OFR 81-16 LA. Mineral Land Classification of Pacific Clay Products, Inc., Clay Deposits in the Alberhill Area, Riverside County, California. By CDMG staff. 1981. A mineral land classification was conducted over a clay-bearing area near Alberhill, Riverside County. Economically important clay in this area occurs in the lower half of the Tertiary Silverado Formation and as a residual capping of the underlying Mesozoic crystalline bedrock. The classified area described in the report is held by Pacific Clay Products, Inc., and serves as a source of clay for the company in manufacturing clay products.

OFR 82-6 LA. Mineral Land Classification of the Riverside Cement Company Platz Property Clay Deposit in Trabuco Canyon, Orange County, California. By R.B. Greenwood. 1982. A mineral land classification study was completed for the Platz property clay deposit located in the Trabuco Canyon area of Orange County. The clay occurs in a succession of non-marine Paleozoic arkosic sandstone and clay beds of the Silverado Formation. Economically significant portions of it are kaolinitic, and have a low iron content and other characteristics that impart a white color to it, making it particularly suitable for manufacturing white cement.

OFR 82-8 LA. Mineral Land Classification of the Pluess-Staufer, Inc., Limestone Deposit. By S.E. Joseph. A mineral land classification study has been completed for a limestone deposit located near Lucerne Valley in western San Bernardino County. The deposit represents a significant source of high-quality limestone. The limestone is currently mined and processed into a marketable product by Pluess-Stauffer. It is used in numerous industrial products throughout California and the rest of the Western states, as well as in Canada. (Supersed by OFR 84-21 LA.)

OFR 82-12 LA. Recent Slope Failures, Ancient Landslides, and Related Geology of the North-Central Coastal Area, San Diego County, California. By F.H. Weber, Jr. Scale 1:24,000. 1981. This report includes a text of 71 pages and 1 plate; most of the cities of Oceanside and Vista, the north parts of the cities of Carlsbad and San Marcos, and unincorporated parts of San Diego County are in the study area. This rapidly urbanizing area totals about 85 square miles. The rains of 1978 and 1980 have caused considerable damage to graded slopes, including some slopes graded for tracts in very recent years. The report represents the first product of a landslide study program in southern California largely funded by the U.S. Geological Survey, Reston, Virginia.

OFR 82-26 LA. Investigation and Inventory of Slope Failures that Occurred in 1978 and 1980 in the Los Angeles 7-1/2-Minute Quadrangle, Los Angeles County, California. By E.Y. Hsu. Scale 1:24,000. 1981. This report consists of a text of 62 pages, a 28 page appendix, and 2 plates. The Los Angeles 7-1/2-minute quadrangle study area comprises approximately 61 square miles about equally divided between highlands and lowlands, with the highlands including parts of the city and county of Los Angeles, and the cities of Monterey Park, Montebello, South Pasadena, and Alhambra. The highlands include a major part of the Repetto Hills and a small part of the Elysian Hills. Slope failure was widespread in the study area in the Repetto Hills during 1978 and 1980, and especially in 1980 in the cities of Los Angeles and Monterey Park. Most of the slope failures consist of shallow debris flows and slides, soil slips, and erosioned rilling and gullying. Only a few deep-seated (bedrock) landslides occurred, all in 1980. The total cost to repair damage to private property is conservatively estimated at $7.5 million.

SAN FRANCISCO REGIONAL OFFICE

OFR 82-19 SF. Geology and Geomorphic Features Related to Landsliding, Glenblair NE 7-1/2' Quadrangle. Compiled by R.T. Kilbourne. 1982. Scale 1:24,000. This map is the first of a series of maps to be released as part of a pilot study to provide regional scale geologic mapping of sensitive north coast watersheds under provisions of Section 208 of the Federal Water Pollution Control Act. The map depicts geology, geomorphic features related to landsliding, and slopes greater than 70 percent. An interpretive legend describing factors affecting landslide potential for each classification accompanies the map.

OFR 82-16 SF. Geology of the Coast Ranges in the Klamath and part of the Ship Mountain Quadrangles, Del Norte County, California. By K.R. Aalto and G.D. Harper. Scale 1:62,500. This areal geologic map was prepared for the California Division of Mines and Geology for use in the compilation of the

1:250,000 Weed quadrangle of the new Regional Geologic Map Series. The mapping is the most detailed work available in this part of the northern Coast Ranges. Franciscan rocks of the area, faults, geologic structure, and details of the boundary between the Coast Ranges and Klamath Mountains geologic provinces are shown on the map.

OFR 82-18 SF. Geology of the Northeast San Bernardino Mountains, San Bernardino County, California. By P.M. Sadler. Scale 1:24,000. Plates A-M (13 sheets). $25.00. The area mapped is largely composed of Precambrian to Mesozoic metamorphic rocks appearing as roof-pendants in large bodies of Mesozoic plutonic rocks. The maps depict pre-plutonic structures and the late Cenozoic tectonics responsible for the present topographic configuration of the San Bernardino Mountains.

OFR 82-22 SF. Geologic and Seismic Hazards Evaluation of the Proposed Little Cojo Bay LNG Terminal Site, Point Conception, California. By S.J. Rice, J.A. Treiman, G. Borchardt, A.L. Jones, L. Mualchin, R.H. Chapman, and R.W. Sherburne. 1981. The report presents an overview of the regional geology within which the proposed Little Cojo Bay LNG site is situated, an evaluation of the seismic potentials of both regional and on-site faults, and recommendations to the California Public Utilities Commission (CPUC) regarding design parameters for the LNG facility. The report is open-filed so that valuable geologic and seismic information can be made available to planners, developers, and reviewers involved in land use planning and assessment of Outer Continental Shelf projects in the Point Conception area of California.

OFR 82-20 SF. Geology and Geomorphic Features Related to Landsliding, Scotia 7-1/2' Quadrangle, Humboldt County, California. By T.E. Spittler. 1982. Scale 1:24,000.

and

OFR 83-3 SF. Geology and Geomorphic Features Related to Landsliding, Bull Creek 7-1/2' Quadrangle, Humboldt County, California. By T.E. Spittler. 1983. Scale 1:24,000.

These maps are a part of a pilot study to provide regional-scale geologic mapping of sensitive north coast watersheds under provisions of Section 208 of the federal Water Pollution Control Act. The maps depict geology, geomorphic features relating to landsliding, and slopes greater than 70 percent. An interpretive legend describing factors affecting landslide potential for each classification accompanies each map. Results of the studies may be used as general background for preparation of timber harvesting plans, and as a guide to land managers for recognizing areas that should receive on-site geologic review prior to development of potentially unstable ground.

OFR 83-10 SF. Summary Report - Fault Evaluation Program, 1981-1982 Area (Northern Coast Ranges Region). By E.W. Hart, W.A. Bryant, and T.C. Smith. 1982. Scale 1:500,000. This report summarizes the results of the fifth of ten areas to be evaluated under the statewide Fault Evaluation Program. During 1981-82, numerous potentially active faults were evaluated relative to the hazard of surface fault rupture. Thirty new and revised special studies zone maps were issued as a result of this work.

OFR 82-21 SF. Geology and Gemorphic Features Related to Landsliding, Crescent City 7-1/2' Quadrangle, Del Norte County, California. Compiled by C.W. Davenport. 1982. Scale 1:24,000.

and

OFR 82-25 SF. Geology and Geomorphic Features Related to Landsliding, Glenblair NW 7-1/2' Quadrangle, Mendocino County, California. Compiled by R.T. Kilbourne. 1982. Scale 1:24,000.

and

OFR 83-4 SF. Geology and Geomorphic Features Related to Landsliding, Hiouchi 7-1/2' Quadrangle, Del Norte County, California. Compiled by C.W. Davenport. 1983. Scale 1:24,000.

and

OFR 83-5 SF. Geology and Geomorphic Features Related to Landsliding, Fort Bragg 7-1/2' Quadrangle, Mendocino County, California. Compiled by R.T. Kilbourne. 1983. Scale 1:24,000.

and

OFR 83-15 SF. Geology and Geomorphic Features Related to Landsliding, Mendocino 7-1/2' Quadrangle, Mendocino County, California. Compiled by R.T. Kilbourne. 1983. Scale 1:24,000.

These maps were released as part of a pilot study to provide regional-scale geologic mapping of sensitive north coast watersheds under provisions of Section 208 of the Federal Water Pollution Control Act. The maps depict geology, geomorphic features relating to landsliding, and slopes greater than 70 percent. An interpretive legend describing factors affecting landslide potential for each classification accompanies each map. Results of the studies may be used as general background for preparation of timber harvesting plans, and as a guide to land managers for recognizing areas that should receive on-site geologic review prior to development of unstable ground.

SACRAMENTO REGIONAL OFFICE

OFR 81-15 SAC. Complete Bouguer Gravity Map - Calistoga, California, and St. Helena, California 15-Minute Quadrangle. By L.G. Youngs, G.W. Chase, and R.H. Chapman. 1981. Scale 1:62,500. Complete Bouguer gravity values for 431 gravity stations are plotted on a base map of the combined Calistoga, and St. Helena, California 15-minute quadrangles. The map depicts the gravity field in a part of the northern Coast Ranges of California between latitudes 38°30' and 38°45' N and longitudes 122°15' and 122°45' W. The area covered by the map includes the northern part of Napa Valley and the geothermal area near the city of Calistoga.

OFR 83-9 SAC. Geophysical Study of the Santa Rosa Geothermal Area, Sonoma County, California. By R.H. Chapman, G.W. Chase, and L.G. Youngs. 1982. A

geophysical study was conducted in the vicinity of Santa Rosa, California, to determine the possibility of locating undeveloped sources of low- to moderate-temperature geothermal energy. Magnetic, gravity, and electrical resistivity surveys were conducted in the study area to determine whether the warm water or the warm water reservoirs could be detected and mapped by these methods. The results of the survey indicate that the sources of the known low-temperature geothermal resources in the area may be within a dense mass of volcanic rocks, and could be the source for additional geothermal resources.

OFR 82-4 SAC. Reconnaissance Geothermal Resource Assessment of 40 Sites in California. Part of the third year report, 1980-81, of the U.S. Department of Energy, California state-coupled program for reservoir assessment and confirmation. By E. Leivas, R.C. Martin, C.T. Higgins, and S.P. Bezore.

and

OFR 83-12 SAC. Reconnaissance Geothermal Resource Assessments of Another 40 Sites in California. Part of the fourth year report, 1981-82, of the U.S. Department of Energy, California state-coupled program for reservoir assessment and confirmation. By E. Leivas and C.F. Bacon.

These reports set forth the results of a reconnaissance-level assessment of low- to moderate-temperature geothermal sites by the Geothermal Resource Assessment Program of the California Division of Mines and Geology. The objective of this investigation was to obtain and publish pertinent information on as many as possible of the known occurrences of natural hot springs and geothermal wells in California, as well as on selected oil, gas, and water wells in the state that appear to have reasonable potential for development as a geothermal resource. The goal is to identify and evaluate those hot springs and wells that have a strong potential for development into significant sources of usable energy, and to identify areas suitable for more intensive area-specific studies. Such areas, with no implied priority, are Elsinore, Tecopa, Twenty-nine Palms, Sierra Valley, Long Valley, Surpise Valley, Big Bend, and Canby-Alturas-Likely.

3. Geology library

The Division's library, located in the San Francisco regional office, is primarily a research and source facility for the Division's professional staff, but it is also open to the public for reference reading and research use. The books, periodicals, maps, and government documents in the collection represent an up-to-date, comprehensive selection of materials of use to Division scientists and investigators.

4. Mineral exhibit

During most of fiscal year 1982-83 the Division's Mineral Exhibit, located on the second floor of the Ferry Building in San Francisco, was open to the general public on weekdays, Monday through Friday, from 8:00 a.m. to 5:00 p.m. On display or available for examination were representative specimens of the rocks and minerals of the state.

On June 20, 1983, the Mineral Exhibit collection was relocated to Mariposa (near Yosemite Valley). There it will be displayed by the county in new facilities planned for construction. The collection was transferred to the care of Mariposa County because continued operation of the exhibit was too expensive for the Division to maintain after the Legislature deleted $3,500 in monthly rent from the budget.

5. Critical-siting report review

The Division provides reviews of geological, seismological, and mineral resource aspects of technical reports produced by other State, federal, and local government agencies. The purpose of the CDMG reviews is to provide assurance to those agencies that the treatment of the geologic, seismological, and mineral resources aspects of those reports has been thorough and accurate, and has applied state-of-the art technical methodology with respect to any geological hazard or mineral resource issues that may be present. Technical information and interpretive judgements are brought to bear in the review process.

During fiscal year 1982-83 siting report review activities included California Coastal Commission site reviews, inspection of the construction of Warm Springs dam, review of the radioactive waste disposal regulations of the Nuclear Regulatory Commission, review of hospital sites, and analysis of Environmental Impact Reports (EIR). Reimbursements for work done by the siting report review unit were provided by the California Public Utilities Commission, the Office of the State Architect, and the California Coastal Commission.

a. Coastal Commission site reviews

A contract with the California Coastal Commission provides for Division staff to review the geologic and seismic safety of proposed developments when requested by the Commission. Reimbursement is on a case-by-case basis, and Division review requires a site visit as part of the engineering geologic appraisal. Most of the work is in southern California where intensive development is occurring in areas of potentially unstable sea cliffs.

b. Environmental impact reports

The Division continued to review Environmental Impact Reports (EIR's) for a variety of projects, outer continental shelf projects including subdivisions, school sites, mining activity, dam sites, and hazardous waste disposal sites. The problems of earthquake shaking, fault rupture, landsliding, erosion, expansive soil, tsunami, subsidence, volcanic eruption, mineral resource conservation, and mined-land reclamation are considered in the review, following the Division's EIR guidelines (CDMG Note 46).

c. Hospital site reports

The Division continued to review reports under the provisions of the Hospital Safety Act (Health and Safety Code), which became effective March 7, 1973. This Act requires that new hospitals, including additions,

reconstructions, and out-patient facilities, be functional during and after an earthquake or other natural disaster. The Division reviewed new and supplemental geologic/seismic hospital-site reports that were submitted by consulting engineering geology firms to the Office of the State Architect. Along with the review activity, Division staff continued to attend regular meetings of the State Building Safety Board and the geotechnical subcommittees to develop new administrative regulations.

d. Other advisory review activities

California Public Utility Commission Project. The Division reviewed the erosion impacts and mitigation measures proposed for selected portions of proposed access road construction along portions of the San Diego Gas and Electric Company 500 KV transmission line project, as requested by the California Public Utilities Commisson (CPUC).

Warm Springs dam site. The Division staff continued to review and examine the geology at Warm Springs dam site as part of the joint federal/State site-review process.

Radioactive Waste Disposal Regulations. The Division reviewed proposed regulations by the Nuclear Regulatory Commission (NRC) on the disposal of high level (HLW) and low level (LLW) radioactive waste. Those NRC regulations, 10CFR60 (HLW) and 10CFR61 (LLW), were finalized during fiscal year 1982-83.

Legislation. Division staff continued the review of State Assembly and Senate bills. The most intensely reviewed bills related to a landslide hazards mapping program and the disposal of low level radioactive waste in California.

Under the leadership of James F. Davis, State Geologist and Chief of the Division, the final phases of a long-term reorganization plan were implemented during fiscal year 1982-83. The reorganization involved a shift in organizational principle. Function rather than geography is the primary principle informing the Division's new organization. Division investigations and studies are now carried out through six functionally defined programs. Each program is managed by a Supervising Geologist who is qualified to evaluate every aspect of the work being done in his program. A seventh Supervising Geologist takes care of program coordination, and manages program planning and, with the aid of the three Regional Administrative Officers, all facilities and support activities within the Division. The new organization is represented diagrammatically in Figure 10.

The Division operates on a quarterly management basis. Preceding each quarter, the management team meets to review program performance for the quarter just ending and to refine program and project goals for the coming quarter and year. The State Geologist, his Deputy, other Headquarters administrative staff, Supervising Geologists, project managers, and Regional Administrative Officers constitute the management team.

Of the 138 permanent personnel in the Division at year's end, 21 were at the Headquarters office in Sacramento, 27 at the 610 Bercut Drive office in Sacramento, 32 at the Sacramento regional office on "O" Street, 33 at the San Francisco regional office in the Ferry Building, and 25 at the Los Angeles regional office in the Civic Center. (For individual names see "II. Personnel" section beginning on page 63.)

I. CDMG Offices

Each of the Division's three regional offices (in Los Angeles, Sacramento, and San Francisco--see Figure 11 for regional boundaries) have an information and publications sales desk. At this desk all Division printed publications, as well as the Division open-file reports pertaining to the particular region, may be examined or purchased. Technical personnel are on hand to respond to inquiries regarding mineral resources or geologic hazards in the region. The regional offices also serve as logistical centers for Division activities. The various activities of the Division's six major programs are conducted as needed at or out of any Division office including the regional offices.

In addition to the three regional offices, there are two other large CDMG offices, both in Sacramento. One is the Headquarters office and the other is the "Bercut" office.

1. Los Angeles regional office

The Los Angeles regional office provides geological information service to all of southern California, an area comprising 11 counties bounded on the north by, and including, the counties of San Luis Obispo, Kern, and Inyo. The office is located in the Junipero Serra Building at 107 South Broadway in the Los Angeles Civic Center.

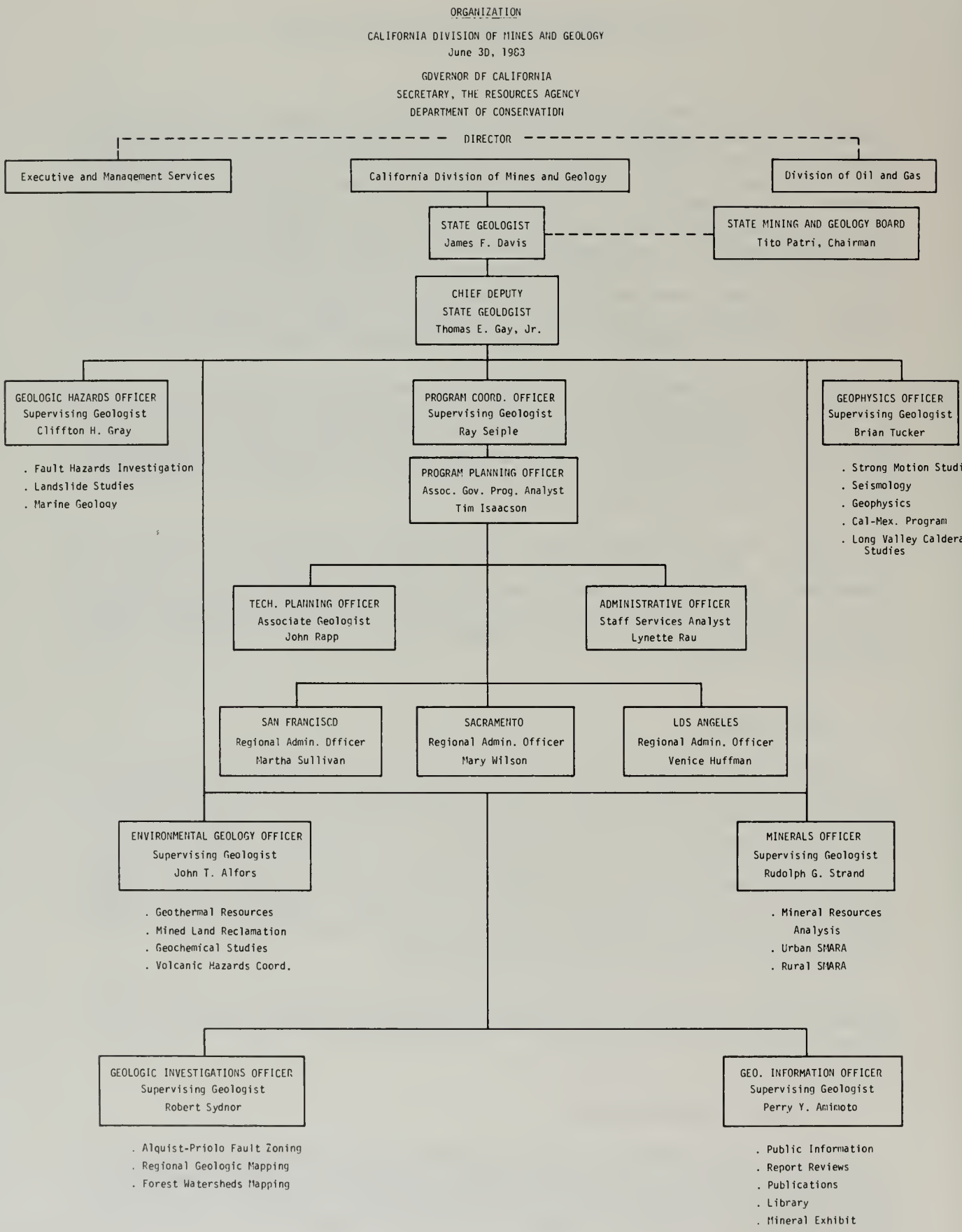
ORGANIZATION
CALIFORNIA DIVISION OF MINES AND GEOLOGY
June 30, 1983
GOVERNOR OF CALIFORNIA
SECRETARY, THE RESOURCES AGENCY
DEPARTMENT OF CONSERVATION
DIRECTOR
Executive and Management Services
California Division of Mines and Geology
Division of Oil and Gas
STATE GEOLOGIST
James F. Davis
STATE MINING AND GEOLOGY BOARD
Tito Patri, Chairman
CHIEF DEPUTY
STATE GEOLOGIST
Thomas E. Gay, Jr.
GEOLOGIC HAZARDS OFFICER
Supervising Geologist
Cliffton H. Gray
. Fault Hazards Investigation
. Landslide Studies
. Marine Geology
PROGRAM COORD. OFFICER
Supervising Geologist
Ray Seiple
PROGRAM PLANNING OFFICER
Assoc. Gov. Prog. Analyst
Tim Isaacson
GEOPHYSICS OFFICER
Supervising Geologist
Brian Tucker
. Strong Motion Studies
. Seismology
. Geophysics
. Cal-Mex. Program
. Long Valley Caldera Studies
TECH. PLANNING OFFICER
Associate Geologist
John Rapp
ADMINISTRATIVE OFFICER
Staff Services Analyst
Lynette Rau
SAN FRANCISCO
Regional Admin. Officer
Martha Sullivan
SACRAMENTO
Regional Admin. Officer
Mary Wilson
LOS ANGELES
Regional Admin. Officer
Venice Huffman
ENVIRONMENTAL GEOLOGY OFFICER
Supervising Geologist
John T. Alfors
. Geothermal Resources
. Mined Land Reclamation
. Geochemical Studies
. Volcanic Hazards Coord.
MINERALS OFFICER
Supervising Geologist
Rudolph G. Strand
. Mineral Resources Analysis
. Urban SMARA
. Rural SMARA
GEOLOGIC INVESTIGATIONS OFFICER
Supervising Geologist
Robert Sydnor
. Alquist-Priolo Fault Zoning
. Regional Geologic Mapping
. Forest Watersheds Mapping
GEO. INFORMATION OFFICER
Supervising Geologist
Perry Y. Amimoto
. Public Information
. Report Reviews
. Publications
. Library
. Mineral Exhibit

Figure 10

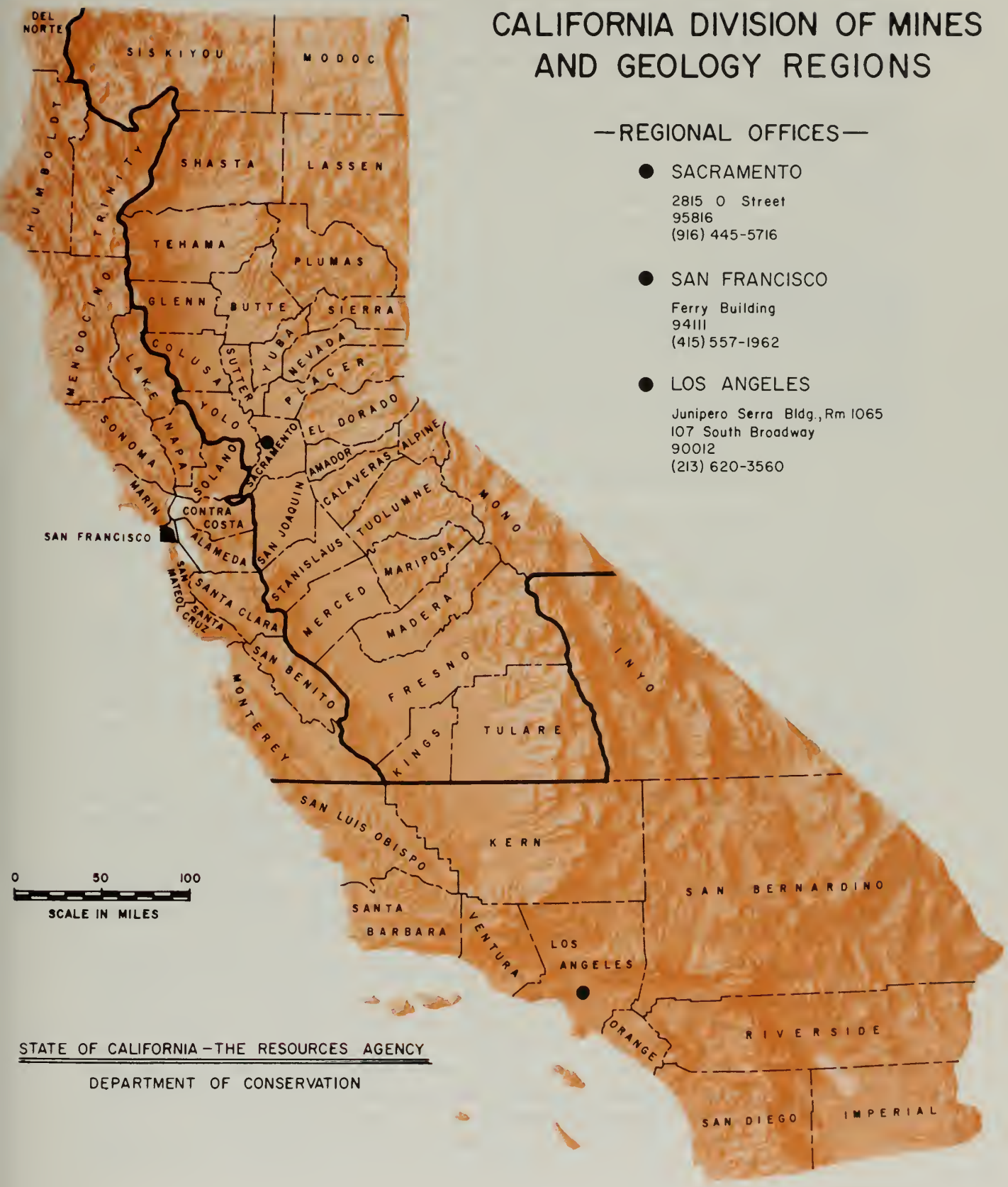

Figure 11. California Division of Mines and Geology information service regions.

The project work of the region includes activities from all the Division's programs. The bulk of the project work of the region, however, is concerned with mineral resources and geologic hazards studies as they relate to proper land use. In the mineral resources studies the emphasis is on the classification, under SMARA, of lands for mineral potential in both the urban and non-urban parts of the region. Much of this work involves cooperative investigations with other governmental agencies, chiefly with the U.S. Geological Survey, but also with local counties. Some are special State studies. In recent years, these investigations have continued to concentrate heavily upon earthquake hazards, including studies of active and potentially active faults, but considerable emphasis has also been placed on slope stability problems.

At year's end the regional staff included one Supervising Geologist, one Regional Administrative Officer, 17 geologists, one geologic aid, two drafting technicians, one seismological service technician, and two secretaries. Small field offices are maintained near projects: currently field offices are located in San Diego (Scripps Institution of Oceanography), Santa Ana, and on the UCLA campus. The Los Angeles regional office maintains a public information and Division publications sale center as well as a small technical library.

2. San Francisco regional office

The San Francisco regional office provides geological information service to 17 counties in northern and central California. This includes approximately two-thirds of the California seacoast, most of the central and northern Coast Ranges, and much of the very active San Andreas fault and related faults.

Several key Division facilities are located at the San Francisco regional office. The Geology Library contains an extensive collection of books, periodicals, and maps from all over the world. The library serves the technical staff of the entire Division. It is also heavily used by the public although it is not a lending library. The Map Room is a depository for U.S. Geological Survey topographic maps and provides maps for geologic field mapping.

Investigations and studies conducted from this office include fault evaluation and zoning (Alquist-Priolo), regional geologic mapping, watersheds mapping related to forestry, and the preparation of stratigraphic sections of locations in California for the Correlation of Stratigraphic Units of North America (COSUNA) project. Secondary activities include support for other programs, including mineral commodities, the Surface Mining and Reclamation Act, and emergency assistance to local governments regarding landslides and earthquakes.

The office staff consists of one Supervising Geologist, one Regional Administrative Officer, 15 geologists, one soil mineralogist, three drafting technicians, two geologic aides, one public inquiries specialist (formerly the museum curator), one librarian, one laboratory technician, three secretaries, and one stock clerk. Five of the 16 geologists are located in the Santa Rosa field office under contract to California Department of Forestry. Use is also made of geologic volunteers and student assistants.

The State Mineral Museum was relocated to Mariposa (near Yosemite Valley) on June 20, 1983. It will be upgraded and displayed in new facilities planned for construction by Mariposa County. The relocation was necessary because the Legislature deleted $3,500 in monthly rent from the 1982-83 fiscal year budget.

The Geochemistry Laboratory has been packed and will be relocated to Sacramento. A small petrographic laboratory will remain in San Francisco.

3. Sacramento regional office

The Sacramento regional office, located at 2815 "O" Street in Sacramento, provides geological information service to 30 counties in central-inland and northeastern California. In addition, it is in this regional office that seismic activity studies, strong-motion instrumentation activities, and geophysical surveys are headquartered.

Staff in the Sacramento regional office consists of one Supervising Geologist, four geologists, one engineering geologist, two geophysicists, six seismologists, two structural engineers, two precision electronics specialists, one photo machine operator, five seismological instrument technicians, two geologic aids, one word processing technician, one information clerk, and five secretaries.

4. Sacramento headquarters office

The Division's headquarters office is located in Room 1341 of the Resources Building at 1416 9th Street in Sacramento. On the same floor are the offices of the Resources Agency and the Department of Conservation, of which the Division is a part.

The staff at Division headquarters provides leadership and support for Division activities throughout the state. The administrative staff sets Division policy, guides program planning, provides program coordination, monitors progress of program projects, maintains budgetary accountability, reviews environmental impact reports and proposed state legislation, edits Division publications including CALIFORNIA GEOLOGY magazine, processes personnel actions, and orchestrates quarterly management meetings.

The headquarters staff consists of the State Geologist and the Deputy State Geologist, three Supervising Geologists, a program planning officer, a staff services analyst, two management services technicians, five geologists (performing administrative, editing, or review functions), a publications editor, and five secretaries.

5. Sacramento "Bercut" office.

The "Bercut" office is located at 610 Bercut Drive in Sacramento. At this office are headquartered staff of both the urban and country mineral land classification (SMARA) units, the geothermal resource studies unit, and the mined-land reclamation unit as well as a publications graphics section.

At year's end the staff headquartered in the "Bercut" office included one Supervising Geologist, one Regional Administrative Officer, 10 geologists, two engineering geologists, one botanist, one publications supervisor, one graphic artist, three drafting technicians, and three secretaries. In addition, several student assistants and volunteers worked out of the Bercut office during fiscal year 1982-83.

II. Personnel: 1. Permanent Division Staff Members, June 30, 1983

HEADQUARTERS OFFICE
1416 9th Street, Room 1341
Sacramento 95814

NAME AND CLASSIFICATION	WORKING TITLE	FUNCTIONAL ASSOCIATION
Amimoto, Perry Y. (Supervising Geologist)	Geologic Information Officer	Administration Geologic Information
Anderson, Mildred E. (Executive Secretary I)	Executive Secretary	Hq. Line Mgmt.
Bezore, Stephen (Associate Geologist)	Editor, CALIFORNIA GEOLOGY MAGAZINE	Publications
Davis, James F. (State Geologist)	State Geologist	Hq. Line Mgmt.
Espinoza, Melissa (Stenographer)	Receptionist	Hq. Support
Gay, Thomas E., Jr. (Chief Deputy St. Geologist)	Chief Deputy State Geologist	Hq. Line Mgmt.
Isaacson, Timothy (Assoc. Gov. Prog. Analyst)	Program Planning Officer	Hq. Program Planning
Johnson, Carole R. (Senior Stenographer)	Secretary	Hq. Program Planning
Johnson, Marti (Office Assistant II -Typing)	Secretary	Hq. Program Planning
Lloyd, Jon C. (Editorial Technician)	Publications Editor	Publications
Rapp, John S. (Associate Geologist)	Technical Planning Officer	Hq. Program Planning
Rau, Lynette (Staff Services Analyst)	Administrative Officer	Administration
Rhodes, Beverly M. (Management Services Tech.)	Business Services Technician	Hq. Program Planning

NAME AND CLASSIFICATION	WORKING TITLE	FUNCTIONAL ASSOCIATION
Seiple, Ray (Supervising Geologist)	Program Coordination Officer	Hq. Program Planning
Silva, Yolanda (Management Services Tech.)	Personnel/Training Coordinator	Hq. Program Planning
Strand, Rudolph G. (Supervising Geologist)	Minerals Officer	Administration, Minerals
Streitz, Robert (Senior Geologist)	EIR Review Officer	Geologic Information
Summerville, Tyrone (Office Assistant II -Typing)	Business Clerk	Hq. Program Planning
Turner, Irene (Word Processing Tech.)	Word Processing Tech.	Headquarters Support
Woods, Mary C. (Associate Geologist)	Chief Editor, CALIFORNIA GEOLOGY MAGAZINE	Publications
Wootton, Tom (Senior Geologist)	Publications Officer	Publications

BERCUT OFFICE
610 Bercut Drive
Sacramento, CA 95814

NAME AND CLASSIFICATION	WORKING TITLE	FUNCTIONAL ASSOCIATION
Alfors, John T. (Supervising Geologist)	Environmental Geology Officer	Administration, Environmental Geology
Bacon, C. Forrest (Senior Geologist)	Geothermal Manager	Administration, Geothermal
Beeby, David J. (Senior Geologist)	Urban SMARA Manager	Administration, Urban SMARA
Burnett, John L. (Associate Geologist)	Geologist	Minerals
Campion, Linda (Assistant Geologist)	Geologist	Geothermal
Cole, Ken (Assoc. Engineering Geologist)	Geologist	SMARA Reclamation
Dupras, Donald (Assistant Geologist)	Geologist	City SMARA
Evoy, Barbara (Assistant Geologist)	Geologist	SMARA Reclamation
Foster, Edward L. (Graphic Artist)	Graphic Artist	Publications
Higgins, Chris T. (Associate Geologist)	Geologist	Geothermal
Huckaby, Louise (Geological Drafting Tech.)	Drafting Technician	Publications
Jones, Allen Lynn (Assistant Geologist)	Geologist	EIR Review
Kohler, Susan B. (Assistant Geologist)	Geologist	Country SMARA
Leivas, Eddie (Associate Geologist)	Geologist	Geothermal
Loyd, Ralph C. (Associate Geologist)	Geologist	Country SMARA

BERCUT OFFICE (Continued)
610 Bercut Drive
Sacramento, CA 95814

NAME AND CLASSIFICATION	WORKING TITLE	FUNCTIONAL ASSOCIATION
Mankoski, Zoe K. (Senior Environmental Planner)	SMARA Reclamation Manager	Administration, SMARA Reclamation
Ota, Yukie (Senior Stenographer)	Secretary to Office Manager	Environmental Geology
Riordan, Danielle P. (Office Assistant II Typing)	Office Assistant II (Typing)	Geothermal
Rubish, Frances T. (Geological Drafting Tech.)	Drafting Technician	Publications
Silva, Mike (Geologic Aid)	Technical Assistant	Regional Geologic Mapping
Smith, R. Merl (Publications Supervisor)	Publications Supervisor	Publications
Tambert, Jeffrey O. (Senior Geological Draft. Tech.)	Drafting Supervisor	Publications
Taylor, Gary (Associate Geologist)	Geologist	Minerals
Van Kekerix, Lorraine (Assoc. Land/Water Use Analyst)	Reclamation Botanist	SMARA Reclamation
White, Darren (Stenographer)	Secretary	Reclamation
Wilson, Mary D. (Regional Admin. Officer)	Office Manager	Administration
Youngs, Leslie G. (Assoc. Engineering Geologist)	Geophysical Geologist	Geothermal

SACRAMENTO OFFICE
2815 O Street
Sacramento, CA 95816

NAME AND CLASSIFICATION	WORKING TITLE	FUNCTIONAL ASSOCIATION
Bennett, John H. (Associate Geophysicist)	Geophysicist	Geophysical Investigations
Blodgett, Juanita G. (Office Assistant II -Typing)	District Clerk	Geophysics Mgmt.
Boylan, Richard T. (Assistant Geologist)	Geologist	Seismology Investigations
Bryant, William A. (Associate Geologist)	Geologist	Alquist-Priolo Fault Evaluation
Burgess, Mary L. (Office Technician -Typing)	Information Clerk	Public Assistance
Campbell, Gordon L. (Geologic Aid)	Geophysicist	Geophysical Investigations
Chapman, Rodger H. (Senior Geologist, Geophyst.)	Geophysics Program Manager	Geophysical Investigations
Chase, Gordon W. (Associate Geophysicist)	Geophysicist	Geophysical Investigations
Cramer, Chris H. (Associate Seismologist)	Seismologist	Regional Geologic Mapping
DaVeiga, Vicki (Seismological Instrument Aid)	Installation Aid	Strong Motion
Farros, Janice (Machine Operator I-Photocopy)	Photo Technician	Strong Motion
Guyer, Albert G. (Precision Elect. Specialist)	Installation Development Specialist	Strong Motion
Hallstrom, Claudia L. (Seismological Instrument Aid)	Installation Aid	Strong Motion
Huston, Marvin M. (Seis. Installation Tech. III)	Lead Installation Technician	Strong Motion

SACRAMENTO OFFICE (Continued)
2815 O Street
Sacramento, CA 95816

NAME AND CLASSIFICATION	WORKING TITLE	FUNCTIONAL ASSOCIATION
Kaliakin, Nikolai A. (Senior Structural Engineer)	Data Systems Manager	Strong Motion
Kishi, Emily H. (Office Assistant II -Typing)	Secretary	Scientific Investigations
McJunkin, Richard D. (Associate Geologist)	Geologist	Strong Motion
Martin, Roger (Senior Engineering Geologist)	Volcanologist	Volcanic Investigation
Mualchin, Lalliana (Associate Seismologist)	Seismologist	Seismology Investigations
Parke, David L. (Geologic Aid)	Earthquake Catalog Coordinator	Seismological Investigations
Pingree, Cora (Word Processing Tech.)	Word Processing Tech.	Geophysics Investigations
Ragsdale, John T. (Senior Structural Engineer)	Operations Manager	Strong Motion
Real, Charles R. (Associate Seismologist)	Seismologist	Seismological Investigations
Rider, Stephen (Seis. Installation Tech. I)	Installation Technician	Strong Motion
Shakal, Anthony (Senior Seismologist)	Strong Motion Manager	Administration, Strong Motion
Sherburne, Roger W. (Senior Seismologist)	Seismology Program Manager	Administration, Seismological Investigations
Syphax, Vernettia G. (Office Technician -Typing)	Secretary to Manager	Strong Motion
Taylor, Wilbert (Seis. Inst. Tech. I)	Service Techician	Strong Motion

SACRAMENTO OFFICE (Continued)
2815 O Street
Sacramento, CA 95816

NAME AND CLASSIFICATION	WORKING TITLE	FUNCTIONAL ASSOCIATION
Toppozada, Tousson R. (Senior Seismologist)	Seismologist	Seismological Investigations
Tucker, Brian (Supervising Geologist)	Geophysics Officer	Administration, Geophysics
Weaver, Sherrill A. (Office Assistant II -Typing)	Fiscal Clerk	Strong Motion
Williams, Wayne W. (Precision Elec. Specialist)	Lead Service Technician	Strong Motion
Young, Phyllis (Office Assistant I -Gen.)	Office Support	Strong Motion

SAN FRANCISCO OFFICE
Ferry Building, Room 1004
San Francisco, CA 94111

NAME AND CLASSIFICATION	WORKING TITLE	FUNCTIONAL ASSOCIATION
Abraham, Delores (Stenographer B)	Secretary	SF Office Support
Appleby, Janet (Geological Drafting Tech.)	Drafting Technician	Publications
Armstrong, Charles F. (Associate Geologist)	Geologist	CDF THP Review
Bedrossian, Trinda B. (Senior Geologist)	Geologist	CDF THP Review
Bishop, Charles C. (Senior Geologist)	Geologist	Regional Geologic Mapping
Borchardt, Glenn A. (Associate Geochemist)	Soil Mineralogist	Scientific Investigations
Bortugno, Edward J. (Associate Geologist)	Geologist	Regional Geologic Mapping
Brunton, Angela (Senior Librarian)	Librarian	SF Library
Coleman, Maude (Office Services Sup. I)	Office Service Supervisor	SF Office Support
Davenport, Clifton (Engineering Geologist)	Geologist	CDF Watershed Mapping
Durrwachter, Ernest C. (Geologic Aid)	Geologic Aid	Regional Geologic Mapping
Hart, Earl W. (Senior Geologist)	Alquist-Priolo Manager	Administration, Alquist-Priolo Fault Evaluation
Huber, Oscar L. (Associate Geologist)	Geologist	CDF THP Review
Jennings, Charles W. (Senior Geologist)	Regional Mapping Manager	Administration, Regional Mapping

SAN FRANCISCO OFFICE (Continued)
Ferry Building, Room 1004
San Francisco, CA 94111

NAME AND CLASSIFICATION	WORKING TITLE	FUNCTIONAL ASSOCIATION
Kelley, Frederic R. (Associate Geologist)	Geologist	CDF Watershed Mapping
Kilbourne, Richard T. (Associate Geologist)	Geologist	CDF Watershed Mapping
Learned, Eleanor M. (Curator, Mineral Museum)	Curator, Mineral Museum	SF Museum
Love, Andrew C. (Stock Clerk)	Stock Clerk	SF Office Support
Majmundar, Hasmukhrai H. (Associate Geochemist)	Geochemical Laboratory Manager	Administration, Geo-Chemical Lab.
Manson, Michael W. (Associate Geologist)	Geologist	City SMARA
Moar, Richard R. (Senior Geological Draftsman)	Drafting Supervisor	Publications
Plappert, John (Jack) (Associate Geologist)	Geologist	City SMARA
Saucedo, George (Assistant Geologist)	Geologist	Regional Geologic Mapping
Smith, Charles B. (Laboratory Technician)	Technical Assistant	CDF Watershed Mapping
Smith, Theodore C. (Associate Geologist)	Geologist	Alquist-Priolo Fault Evaluation
Spittler, Thomas E. (Associate Geologist)	Geologist	CDF Watershed Mapping
Stinson, Melvin C. (Senior Geologist)	Minerals Manager	Administration, Minerals
Stone, Renita (Office Assistant II-Typing)	Secretary	SF Clerical Support

SAN FRANCISCO OFFICE (Continued)
Ferry Building, Room 1004
San Francisco, CA 94111

NAME AND CLASSIFICATION	WORKING TITLE	FUNCTIONAL ASSOCIATION
Sullivan, Martha (Regional Admin. Officer)	Office Manager	Administration
Sydnor, Robert (Supervising Geologist)	Geological Investigations Officer	Administration, Geologic Investigations
Taylor, Eleanor (Geological Drafting Tech.)	Drafting Technician	Publications
Wagner, David L. (Associate Geologist)	Geologist	Regional Geologic Mapping
Wong, Perry (Geologic Aid)	Geologic Aid	Alquist-Priolo Fault Evaluation

LOS ANGELES OFFICE
107 S. Broadway
Los Angeles, CA 90012

NAME AND CLASSIFICATION	WORKING TITLE	FUNCTIONAL ASSOCIATION
Anderson, Thomas P. (Senior Geologist)	Country SMARA Manager	Administration, Country SMARA
Barrows, Allan G. (Senior Geologist)	Geologist	Geologic Investigations
Bushnell, Marjorie M. (Associate Geologist)	Geologist	Minerals
Cardenas, Florencia (Office Assistant II-Bilingual)	Secretary	Cal-Mexico
Cole, Judy (Assistant Geologist)	Geologist	City SMARA
Frasse, Jeanne (Geologic Aid)	Technical Assistant	Landslide Hazards Investigations
Fuller, David R. (Associate Geologist)	Geologist	City SMARA
Gray, Cliffton H., Jr. (Supervising Geologist)	Geologic Hazards Officer	Administration, Geohazards
Greenwood, Richard B. (Associate Geologist)	Geologist	Country SMARA
Hsu, Eugene Y. (Associate Geologist)	Geologist	Regional Geologic Mapping
Huffman, Venice (Regional Admin. Officer)	Office Manager	Administration
Joseph, Stephen (Assistant Geologist)	Geologist	Country SMARA
Kahle, James E. (Associate Geologist)	Geologist	Geologic Investigations
Kiessling, Edmund W. (Associate Geologist)	Geologist	EIR Review

LOS ANGELES OFFICE (Continued)
107 S. Broadway
Los Angeles, CA 90012

NAME AND CLASSIFICATION	WORKING TITLE	FUNCTIONAL ASSOCIATION
NeSmith, Esther (Office Assistant II -Typing)	Information Clerk	LA Office Support
Owens, Charles (Geological Drafting Tech.)	Drafting Technician	Publications
Reichle, Michael (Senior Seismologist)	Program Manager	Cal-Mexico
Saul, Richard B. (Associate Geologist)	Geologist	Geologic Investigations
Stickney, Dale (Geological Drafting Tech.)	Drafting Technician	Publications
Treiman, Jerome A. (Associate Geologist)	Geologist	Advisory Services
Weber, F. Harold, Jr. (Senior Geologist)	Geologist	Landslide Hazards Investigations

GEOLOGICAL RESEARCH DIVISION
Scripps Institute of Oceanography
La Jolla, CA 92037

NAME AND CLASSIFICATION	WORKING TITLE	FUNCTIONAL ASSOCIATION
Kennedy, Michael P. (Marine Geologist)	Marine Geologist	Coastal Commission/ Oceanographical Studies

MINERALS PROGRAM
28 Civic Center Plaza, Room 642
Santa Ana, CA 92701

NAME AND CLASSIFICATION	WORKING TITLE	FUNCTIONAL ASSOCIATION
Miller, Russel V. (Associate Geologist)	Geologist	Urban SMARA
Tan, Siang S. (Associate Geologist)	Geologist	Advisory Services

STRONG MOTION INSTRUMENTATION PROGRAM
303 W. 3rd Street, Room 148
San Bernardino, CA 92401

NAME AND CLASSIFICATION	WORKING TITLE	FUNCTIONAL ASSOCIATION
Lagesse, Harry P. (Seis. Instrument Tech. II)	Service Technician	Strong Motion

NEW HIRES
July 1, 1982 - June 30, 1983

NAME	CLASSIFICATION	DATE
Coleman, Maude	Office Services Super. I	12/02/82
Evoy, Barbara	Assistant Geologist	09/20/82
Frasse, Jeanne	Geologic Aid	08/02/82
Goodman, Bill	Student Assistant	07/20/81
Griffith, Peter	Student Assistant	09/82
Healy, Marie	Student Assistant	08/10/82
Isaacson, Timothy	Assoc. Government Program Analyst	12/28/82
Johnson, Peggy	Student Assistant	09/15/82
Owens, Charles	Geological Drafting Technician	12/27/82
Reichle, Michael	Senior Seismologist	08/30/82
Religioso, Solita	Office Assistant II (T)	10/25/82
Seiple, Ray	Supervising Geologist	11/02/82
Smith, Russell	Seismological Instrument Tech. I	11/02/82
Stange, Larry	Seismological Instrument Tech. I	12/13/82
Stone, Renita	Office Assistant II(T)	08/17/82
Sullivan, Martha	Regional Administrative Officer	09/01/82
Sydnor, Robert	Supervising Geologist	10/29/82
Taylor, Wilbert	Seisismological Instrrment Tech. I	12/31/82
Thompson, William	Student Assistant	12/15/82
Tucker, Brian	Supervising Geologist	12/20/82
Williams, James	Geological Drafting Technician	12/28/82

PROMOTIONS
July 1, 1982 - June 30, 1983

NAME	CLASSIFICATION	PROMOTION	DATE
Healy, Marie	Student Assistant	Grad. Student Asst.	11/02/82
Huffman, Venice	Senior Account Clerk	Regional Admin. Officer	07/82
Rubish, Frances	Management Serv. Tech.	Geo. Drafting Tech.	11/02/82
Young, Phyllis	Office Assistant I (Gen)	Office Assistant I (T)	07/82

SEPARATIONS
July 1, 1982 - June 30, 1983

NAME	CLASSIFICATION	DATE
Bane, Dennis	Student Assistant	01/20/83
Devney, Ann	Word Processing Tech.	05/27/83
Griscom, Sarah	Student Assistant	12/10/82
Mata-Sol, Anibal	Student Assistant	04/14/83
O'Flynn, Diane	Office Assistant II	09/30/82
Parh, Sharon	Student Assistant	01/18/83
Religioso, Solita	Office Assistant II	04/29/83
Schadt, Liese	Student Assistant	07/01/82
Smith, Russell	Seismological Instrument Tech. I	05/10/83
Zeh, Cheryl	Editorial Aid	06/03/83

TRANSFER TO ANOTHER STATE AGENCY

NAME	CLASSIFICATION	DATE
Buchholz, Harold	Seism. Instr. Tech. I	09/20/82
DeGusman, Meryln	Laboratory Technician	12/30/82
Dye, Jack	Staff Services Manager I	12/06/82
Gasner, Laura	Office Services Supervisor I	11/82
Lindgren, Betty	Senior Geological Draft. Tech.	12/15/82
Luzier, Charles	Seism. Instr. Tech. III	03/11/83
Meneely, Robert	Seism. Instr. Tech. I	10/08/82
Rasnic, John	Seism. Instr. Tech. I	12/01/82
Stratton, Anna	Geological Drafting Tech.	06/14/83
Torres, Sue	Office Technician	12/24/82

RETIREMENTS

Morgan, Ron	Graphic Artist	03/01/83
Rice, Salem	Senior Geologist	03/02/83

DECEASED

Morgan, Ron	Graphic Artist	07/09/83

III. Budget Summary, 1982-83

Expenditures by Program Component

Geologic Hazards and Mineral Resources Conservation Program

	Personnel Years	Dollars	Personnel Years	Dollars
Land Use Geology and Seismology Element			89.3	3,843,000
Basic Investigations Component	70	2,916,000		
Hazards Reduction Component	19.3	927,000		
Mineral Resources Conservation Element			35.8	1,712,000
Deposit Inventory Component	12.8	578,000		
Land Classification Component	17.5	882,000		
Mined Land Reclamation Component	5.5	252,000		
Geologic Information and Publication Element			23.3	1,178,000
Information Component	9.6	419,000		
Publications Component	13.7	759,000		
Administration Element			11.00	1,354,000
TOTAL EXPENDITURES			159.4	8,087,000

Source of Funds

General Fund	3,984,000
Surface Mining and Reclamation Account, General Fund	1,134,000
Strong-Motion Instrumentation Program Fund	1,547,000
Energy and Resources Fund	535,000
State Highway Account, State Transportation Fund	11,000
California Water Fund	11,000
Federal Trust Fund	181,000
Reimbursements	684,000
TOTAL	8,087,000

IV. Statutory Authority for the Division

The Division of Mines and Geology operates under the authority provided in the State Public Resources Code, significant parts of which are summarized as follows:

Division 1. Administration

Chapter 2. Department of Conservation

Article 1. Organization and general powers

Section 601. Established the Department of Conservation in the Resources Agency and identified the role of the Director.

Section 607. The work of the Department is divided into three divisions, known as the Division of Mines and Geology, Division of Oil and Gas, and the Division of Resource Conservation.

Article 3. State Mining and Geology Board

Sections 660-676. Establishes the Board and its responsibilities.

Section 677. The Board shall nominate and the Director shall appoint the State Geologist. Describes the qualifications of the State Geologist.

Section 678. Provides the authority of the State Geologist.

Division 2. Geology, Mines, and Mining

Chapter 2. The Division of Mines and Geology (Sections 2201-2209 inclusive)

Section 2201. State Geologist shall employ geologists and qualified specialists to do Division's work.

Section 2203. State Geologist shall submit an annual report, including review of measures taken to counter geologic hazards, and review of economic utilization and conservation of State's mineral resources and problems related thereto, pursuant to the State Mining and Minerals Policy (Section 2650).

Section 2204. State Geologist may receive and manage gifts on behalf of State.

Section 2205. State Geologist may: Study mineral resources, mineral industries, and geology of the state; Collect mineral statistics; Collect geological and mineralogical specimens and models to constitute Division's exhibits; Provide technical library to be Division's library;

Maintain, in effect, a bureau of information on the State's mineral industries; Conduct studies of geologic hazards in urban area, including activities under cooperative agreements; Maintain a laboratory to perform physical and chemical tests and analyses; Issue reports and maps on the geology of the state and the statistics and technology of the State's mineral industries; Conduct investigations in mining and metallurgy, including use of scrap mineral products, and in land-use practices applicable to mineral resources conservation; Conduct investigations in reclamation and utilization of mining waste products and reclamation of mined lands.

Section 2207. Mineral producers shall forward to the State Geologist, upon his request, annual mineral production figures. Such reports shall be confidential. State Geologist shall compile and publish statistical bulletins to show totals of minerals produced, annually.

Section 2207.1 Manufacturers or processors may, upon request, report to the State Geologist data on consumption or utilization of mineral materials. Such reports shall be confidential.

Section 2209. State Geologist may fix prices upon and dispose to the public all publications of the Division.

Chapter 7.5 Special Studies Zones
(Sections 2621 - 2630 inclusive)

Section 2622. State Geologist shall delineate Special Studies Zones to encompass potantially and recently active faults under the Alquist-Priolo Special Studies Act. He shall continually review new geologic and seismic data and revise or issue new special studies zones when warranted by new information.

Chapter 7.6. State Mining and Minerals Policy

Section 2650. Establishes the State Mining and Minerals Policy and requires the State Geologist to carry out such policy. He may include in his annual report to the Director (Section 2203) recommendations for items of legislations necessary to implement such policy.

Chapter 8. Strong Motion Instrumentation Program (Sections 2700 - 2709 inclusive)

Establishes the strong-motion instrumentation program and describes the role of the Division of Mines and Geology in its implementation.

Chapter 9. Surface Mining and Reclamation Act of 1975 (Sections 2710 - 2793 inclusive)

Establishes the Surface Mining and Reclamation Act of 1976 to regulate surface mining operations. Identifies the role of the State Geologist and the Mining and Geology Board. Requires the Board to adopt State policy for the reclamation of mined lands. Requires the State Geologist to classify lands as to their mineral potential.

V. State Mining and Geology Board

The State Mining and Geology Board is a nine-member board. Each member is appointed by the Governor to serve a four-year term. The Governor designates the chairman, who shall hold such office at the Governor's pleasure. The vice chairman is elected annually.

The Board's responsibilities, as stated in Sections 672-677 of the Public Resources Code, are as follows:

> "The Board shall represent the state's interest in the development, utilization, and conservation of the mineral resources of the state and the reclamation of mined lands, as provided by law, and federal matters pertaining to mining, and shall determine, establish, and maintain an adequate surface mining and reclamation policy. The Board shall also represent the state's interest in the development of geological information necessary to the understanding and utilization of the state's terrain, and information pertaining to earthquake and other geologic hazards. General policies for the Division shall be determined by the Board.
>
> "The Board shall also serve as a policy and appeals board for the purposes of the Alquist-Priolo Special Studies Zones Act (Chapter 7.5, Division 2, Public Resources Code).
>
> "On or before December 31 of each year, the Board shall submit to the Governor and the Legislature recommendations regarding needed research projects relating to the state's terrain, mineral resources, mining, the reclamation of mined lands, and earthquakes and other geologic hazards.
>
> "The Board may provide for a statewide program of research regarding the technical phases of reclaiming mined lands which may be delegated to it by law and may accept funds from the United States or from any person to aid in carrying out the provisions of this section. The Board may conduct such a program independently or by contract or in cooperation with any person, public or private organization, federal agency, or state agency, including any political subdivision of the state.
>
> "The Board shall provide for a public information program on matters involving the state's terrain, mineral resources, mining, the reclamation of mined lands, and earthquakes and other geologic hazards.
>
> "In accordance with the State Civil Service Act, the Board shall nominate, and the director shall appoint, . . . the State Geologist . . ."

The State Mining and Geology Board's Annual Report to the Governor and the Legislature is printed separately by the Board.

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SEVENTY—FIFTH REPORT OF THE STATE GEOLOGIST (1982–1983)